SPORTS INJURIES

THEIR PREVENTION AND TREATMENT

BY

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WITH A FOREWORD BY

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BRISTOL JOHN WRIGHT & SONS LTD

1957

PRINTED IN GREAT BRITAIN BY
JOHN WRIGHT & SONS LTD.
AT THE STONEBRIDGE PRESS, BRISTOL

PREFACE

INJURY is the occupational hazard of sport, but the treatment of these injuries does not receive a commensurable degree of attention or foresight by those doctors and physiotherapists responsible for treating the athlete.

As a result of his experiences with athletes (both amateur and professional) of many sports, the author is convinced that a different approach and a greater sense of urgency are required adequately to cope with the recent injuries of everyday life. To cater for this need the author advocates the high pressure systems of treatment used very successfully during a number of years with professional football and cricket clubs and outlined in this volume.

The author wishes to express his gratitude to various people who have materially contributed to the writing of this book, and to those who assisted the author in obtaining the experience that formed the foundations for the techniques described herein.

Amongst these valuable aids, the advice and help given by Mr H Kearton, M C.S.P Superintendent Physiotherapist to the Central Middlesex Hospital during the author's early days in the world of sport the experience gained whilst working with Dr C. R. Woodard in his Athlete's Injury Clinic and the valuable backing and support given by Mr H. H Langston F R.C S Honorary Consultant Surgeon to the Southampton Football Club and Dr D B Ramsay, Honorary Physician to the same club Thanks are also due to Mr Langston's staff at the Royal South Hants Hospital Southampton for their aid in obtaining many of the radiographs used in the book and to Mr Pat Parker, who carried out much of the photography most of it at the premises of Southampton Football Club and for his help in Case History No 54, of which he was the subject.

The author also feels that the advice and time so freely given by Sir Arthur Porritt, K.C.M.G., K.C.V.O., C.B.E., in writing the Foreword to the book represents an honour and is a source of great pride.

Finally the author is deeply grateful to the publishers for their pleasant display of confidence throughout the production of what it is hoped will become a valued aid to all those who have the responsibility of returning an injured athlete to his chosen sport.

D. F. F.

Southampton
February 1957

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FOREWORD

By Sir Arthur Porritt, K.C.M.G., K.C.V.O., C.B.E.

It is a remarkable fact that in a country where games are such an essential part of national life, the subject of sports injuries has received relatively so little attention. Their treatment, at any rate in the vital early stages, has been very largely empirical and often almost primitive. And yet their significance, not only from the athletic but also the economic point of view, is of the greatest importance.

Mr Featherstone's book is therefore very welcome and the case he puts is that of the scientifically trained physiotherapist, lucid, practical, and based on a wealth of personal experience. His thesis that the qualified physiotherapist, if suitably placed at the site of sports activities, forms the ideal intermediary in the early stages of athletic injuries between the player and the doctor would seem as sound as his belief that the same physiotherapist is the ideal assistant to the doctor in the later stages of rehabilitation.

He stresses the great importance of linking up with physical measures a sound and sympathetic psychological approach to the patient.

His physical methods are divided into the so-called pressure system, which implies a concentrated course of treatment applicable primarily to the professional player, and the home system for the use rather of the amateur athlete

The descriptions of the various injuries are clear and their treatment essentially practical. Each is well illustrated by case histories based on personal experience.

Mention is made of many conditions which might be considered perhaps really medical but as the author so reasonably points out they are all such as may be met with as emergencies by the physiotherapist interested in and dealing with such casualties—and after all, this book is written primarily for physiotherapists Throughout, the balance between the latter and the medical profession is well held, and the book as a whole places much valuable substance into what has previously been rather a pathetically aching void.

SPORTS INJURIES

CHAPTER I

THE INCIDENCE AND TYPE OF INJURY

Sources of information concerned with the type and the frequency of sports injuries are difficult to find and few in number. Medical personnel working in sport appear to maintain few records, but those that exist show interesting details of considerable value. Possibly the leading source of such information is contained in *Athletic Injuries—Prevention Diagnosis and Treatment*, by Dr Augustus Thorndike, in which are recorded the types and incidence of injuries at Harvard University, U.S.A., during a fifteen year period.

Statistics of casualties incurred in sport at Cambridge University over an undefined period have been revealed by Mr R. Salisbury Woods, F.R.C.S. At this seat of learning, rugger soccer cricket, rowing hockey track and field athletics, boxing, etc., take place on a wide scale. It is felt that the most serious, or potentially serious, injuries are chronic sprains of the ankle and knee joints, dislocations of elbow and ankle, fractures, concussion, and, more rarely internal injuries. The order of games in proportion to injury are as follows —

		Seasonal percentage
1	Rugby football	12·2
2.	Boxing	5 1
3	Association football	4·6
4.	Cross-country running	1 5
5	Ice hockey	1 4
6	Track and field athletics	1 3
7	Rowing	1 2
8	Swimming	Nil
9.	Fencing	Nil

The presence of both codes of football in the first three of the table is possibly due to a typical student tradition of ignoring all risks when going for the man or the ball. In the opinion of Mr Salisbury Woods further factors in this connexion lie in the lack of proper training, the playing of men

A recent poll conducted in America and dealing with the injuries sustained in American-style football is rather breath-taking. It shows that three out of four players suffered injuries sufficiently severe to keep them out of the team for at least four days, and twice as many injuries were sustained in practice as in actual matches. Many knee and ankle injuries are apparently of such a severe nature as to cause the player to have recurrent trouble with them throughout his playing career. The poll covered 4000 players of 62 colleges during 601 games and showed 733 teeth chipped or knocked out, 578 sprained ankles, and 53 strained knees. On the 1 per 1000 ratio there were 120 sprained ankles, 180 damaged teeth, 110 strained knees, 100 pulled muscles, 60 concussions, 40 shoulder strains, 6 fractures of the ankle, 5 fractured lower legs, 4 fractured radius and ulna, and 1 fractured spine.

Surprisingly, records show boxing to be favourably placed with relatively minor non-serious injuries. These include sprained thumbs, black eyes, fractured noses, split lips, and chipped or broken teeth, but few permanent scars or injuries. Frank Lloyd, George Deaver and Floyd Eastwood in the American study of Safety found boxing to be an activity of minimum hazard in high school, having an incidence of less than 1 accident per 1000 opportunities. In college, the incidence increases to 4·6 per 1000 and in a listing of sports according to their incidence of injuries, boxing was seventh, with football, wrestling, lacrosse, and rowing considered more dangerous.

The Catalonia Federation of the Spanish Football Association recently carried out a special investigation into the number and types of injuries sustained in Spanish football. During season 1951–2 the listing of the number of injuries to different parts of the body was as follows:—

1	Knees	284	10	Wrist	49
2	Ankles	178	11	Elbow	44
3	Thighs	123	12	Pelvis	25
4	Lower leg	85	13	Spine	23
5	Hand	82	14	Skull	22
6	Foot	80	15	Hip	16
7	Face	62	16	Forearm	16
8	Shoulders	61	17	Upper arm	10
9	Chest	57	18	Abdomen	10
			19	Neck	2

who are over tired, and the inadequate medical supervision of doubtfully-fit players.

The statistics of the Carnegie Foundation show that, at twenty two American universities with 43,923 participants in inter-collegiate sport, about 3 per cent of all men who took part sustained serious or potentially serious injuries. They were classified as follows —

Chronic sprains disabling for more than 3 weeks	523
Dislocations	318
Concussions	240
Fractures	188
Collapse	30
Internal injuries	21
TOTAL	1320

A number of small-scale researches into sports injuries have been carried out by means of circulated questionnaires. Thus track and field athletics showed pulled muscles at the top of the list, followed by sprains and injuries to the Achilles tendon region. In women's hockey bruised shins, strains and sprains were the most common injuries, with a small number of meniscus lesions. The most serious, but infrequently encountered are fractures of the legs, fingers, and nose with concussion occupying a surprisingly high place on the list. A similar small-scale research carried out amongst 120 professional footballers showed that they estimated their most common injuries to be —

a. In order of frequency —

Ankle injuries
Pulled muscles
Knee injuries
Groin injuries
Fractures
Bruising
Abrasions of a relatively severe nature

b In order of severity —

1st	*2nd*	*3rd*
Ankle	Ankle	Muscle strain
Knee	Knee	Knee
Muscle strains	Muscle strains	Ankle
Fractures	Groin strain	Miscellaneous

The most often mentioned ankle injury is the sprain when a site is indicated for pulled muscles it is mostly the thigh, but often no site is mentioned. Knee injuries, where specified, usually relate to meniscus lesions or torn ligaments.

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8	Shoulders	61	17	Upper arm	10
9	Chest	57	18.	Abdomen	10
19	Neck	2			

Of a more comprehensive nature are the records maintained at Southampton Football Club, an English professional club. Detailed records were kept over a three-year period, during which time the numbers and types of injuries received by the players during the three seasons under review were as follows —

	1951–2	1952–3	1953–4
Sprains	65	85	47
Strains	97	90	46
Simple contusions	121	109	83
Muscle contusions	90	60	45
Lacerations, abrasions	158	137	146
Infections	19	27	8
Fractures, dislocations	7	6	6
Inflammations	89	63	60

The list of injury distribution to parts of the body was as follows —

		1951–2	1952–3	1953–4
1	Knees	127	131	127
2	Thighs	87	115	89
3	Feet	83	86	67
4.	Calves	98	53	38
5	Ankles	79	49	37
6.	Heels	28	50	21
7	Shins	57	19	23
8.	Back	28	18	9
9.	Arms	24	18	15
10.	Face	17	24	14
11	Hands	23	14	8
12.	Shoulders	18	18	3
13	Achilles tendon	18	13	3
14.	Chest	16	7	5
15	Neck	13	5	1
16.	Wrists	12	2	3
17	Groins	10	3	8
18	Hips	8	3	5
19	Elbows	8	2	6
20.	Head	5	4	3
21	Buttocks	6	1	1
22.	Abdomen	1	4	—
23	Iliac crest	4	1	3
	TOTALS	769	590	489

The gravity of an injury both to the athlete and to his team, is governed by three factors firstly, the period for which he is out of action secondly the amount of physical training that is missed and, thirdly the number of actual games or contests that he is forced to miss. The first and last factors are self-explanatory the second one is important because

it is no use rapidly clearing up an injury if, in the meantime, the athlete has been permitted to become unfit for immediate action because of his inability to carry out his physical training

Over a period of three seasons at Southampton F C the more serious injuries (i.e. those causing at least one game to be missed) were as given below Also included is the total period of incapacity, the number of missed days of training and the number of missed games.

Diagnosis	*Period of Incapacity*	*Training Days Missed*	*Games Missed*
Injuries to the Knee Joint:—			
Medial ligament strain	13 d.	3 (6 d. lt. trg only)	3
Ditto	10 d.	3 (2 d. lt. trg.)	2
Ditto	3½ wk.	1 (11 d. lt. trg.)	3
Ditto	2 wk.	(3 d. lt. trg.)	2
Ditto	2 wk.	7 (3 d. lt. trg.)	2
Lateral ligament strain	2 wk.	7 (1 d. lt. trg.)	2
Ditto	12 d.	4 (2 d. lt. trg.)	2
Ditto	3 wk.	(12 d. lt. trg.)	3
Ditto	10 d.	(2 d. lt. trg.)	1
Rupture lateral ligament with rupture anterior cruciate ligament	3½ mth.	20 (57 d. lt. trg.)	17
Lateral meniscus lesion (menisectomy)	6 wk.	12 (15 d. lt. trg.)	12
Medial meniscus lesion (menisectomy)	9 wk.	16 (34 d. lt. trg.)	4 (Off season injury)
Contusion, with effusion and extracapsular haematoma	1 wk.	4 (3 d. lt. trg.)	3
Infrapatella bursitis	1 wk.	2 (4 d. lt. trg.)	1
Quadriceps insufficiency with effusion	2 wk.	7 (7 d. lt. trg.)	3
Injuries to the Trunk:—			
P I D lumbar 4/5	1 wk.	4	1
Injuries to the Shoulder Joint:—			
Strain supraspinatus	10 d	7 (3 d. lt. trg.)	1
Contusion acromioclavicular joint	5 d.	(3 d. lt. trg.)	1
Injuries to the Face:—			
Laceration right eyebrow	10 d.	6	2
Bell's palsy	3 wk.	2 wk.	3

Diagnosis	*Period of Incapacity*	*Training Days Missed*	*Games Missed*
Fractures and Dislocations:—			
Dislocation 1st interproximal joint forefinger	2 wk.	2	2
Fractured tibia	12 wk.	2 wk. (10 wk. lt. trg.)	8
Ditto	3 mth.	Mostly off season	9
Fractured jaw	2 mth.	1 mth. (5 d. lt. trg.)	9
Fractured tibia	6 mth	60	13
Fractured fibula	6 wk.	16 (25 d. lt. trg.)	9
Fractured ulna	9 wk.	Entirely off-season	
Injuries to the Ankle Joint:—			
Strain, anterior fasc. lateral ligament ankle	10 d.	2 (6 d. lt. trg.)	2
Ditto	5 d.	(5 d. lt. trg.)	1
Ditto	2½ wk.	2 (8 d. lt. trg.)	2
Ditto	2 wk	(9 d. lt. trg.)	2
Strain, talo-fibula ligament	10 d.	4 (6 d. lt. trg.)	2
Injuries to the Thigh:—			
Chronic adductor strain	7 mth.		2
Ditto	5 mth.		1
Ditto	9 wk.		1

These strains lasted almost throughout the season, and had to be treated constantly to keep the man playing; hence each man had intermittent periods of light training. They were all eventually cured by means of a manipulation under anaesthetic.

Diagnosis	*Period of Incapacity*	*Training Days Missed*	*Games Missed*
Encysted haematoma quadriceps	3 wk.	2 wk. (1 wk. lt. trg.)	2
Myositis ossificans quadriceps	6 wk.	5 wk.	6
Adductor strain (periosteal attachment)	12 d.	2 (5 d. lt. trg.)	2
Contusion quadriceps	3 d.	(2 d. lt. trg.)	1
Strain biceps femoris	9 d.	5 (3 d. lt. trg.)	1
Ditto	8 d.	3 (2 d. lt. trg.)	1
Strain rectus femoris	10 d.	7 (2 d. lt. trg.)	1
Contusion fascia lata region	6 d.	2	1
Ditto	4 d.	1 (1 d. lt. trg.)	1
Injuries to the Feet:—			
Septic condition foot	7 d.	6	1
Contusion great toe	3 wk.	3 (15 d. lt. trg.)	3
Sprain joints 3, 4, 5 tarso-metatarsal	2 wk.	3 (1 d. lt. trg.)	2
Mid-tarsal strain	2 wk.	10	2
Strain (concussed) 1st metatarsal/cuneiform joint	1 wk.	3 (2 d. lt. trg.)	1

The numbers and types of specific injuries sustained in three seasons are interesting and enlightening being classified under the same headings as the overall list of injuries

SPRAINS

	1951–2	1952–3	1953–4
Ankle Sprains:—			
Ant. fasc. lat. lig	16	24	12
Middle fasc. lat. lig.	8	5	5
Medial lig	3	6	4
Tibiofibular lig	1	4	1
No ligaments mentioned	2	1	3
	30	40	25
Knee Sprains:—			
Medial collateral lig	10	11	4
Lateral collateral lig	7	13	9
Capsular	7	7	3
	24	31	16
Other Sprains:—			
Wrist	2	2	2
Tarsometatarsal great toe	1	1	2
Thumb	3	5	1
Interphalangeal jt. little finger	2	1	2
Metacarpophalangeal jt. forefinger	2	2	—
Sacro-iliac	—	2	—
Tennis elbow	5	—	—
First metatarsocuneiform jt.	1	—	—
	16	13	7
TOTALS	70	84	48

STRAINS

Muscular Strains:—

1 *Part of Body*

	1951–2	1952–3	1953–4
Foot	6	8	3
Lower leg	7	17	2
Thigh	19	30	20
Groin	3	1	4
Abdomen	1	—	—
Buttocks	1	—	—
Hip	—	—	—
Chest	1	—	—
Back	25	14	4
Shoulder	7	7	—
Arms	5	2	—
Neck	3	5*	2
TOTALS	78	84	35

* Including fibrositis

Muscular Strains (*cont.*):—

2. *Muscle Groups Involved*

	1951–2	1952–3	1953–4
Lower Leg			
Gastrocnemius	5	13	3
Thigh			
Hamstrings	8	12	3
Quadriceps	1	5	4
Rect. femoris	6	6	9
Groin			
Hip flexors	—	1	—
Adductors	8	9	8
Back			
Erector spinæ	25	14	3*
Shoulder			
Deltoid	2	—	—
Lat. dorsi	1	—	—
TOTALS	56	60	30

* Including prolapsed intravertebral disk lesion.

CONTUSIONS

1 *Muscle Contusions*

	1951–2	1952–3	1953–4
Foot	13	4	5
Leg	12	22	11
Thigh	20	25	19
Hip	2	—	2
Buttocks	3	1	1
Chest	6	4	4
Back	—	2	1
Hand	1	—	1
Arm	—	2	2
Shoulder	2	—	2
Neck	—	—	—
Head	—	—	—
Knee	1	—	—
TOTALS	60	60	48

2. *Superficial Contusions*

	1951–2	1952–3	1953–4
Foot	14	8	9
Leg	37	17	11
Thigh	20	10	16
Hip	2	2	1
Buttocks	2	—	—
Abdomen	—	3	—
Back	1	—	—
Hand	1	—	—
Arm	1	2	1
Shoulder	1	1	1
Neck	—	—	—
Chest	—	2	1
Face	1	1	1
TOTALS	80	46	41

3 *Joint Contusions*

	1951–2	1952–3	1953–4
Foot	5	14	15
Ankle	17	9	12
Knee	20	25	9
Hip	4	1	3
Shoulder	3	10	—
Elbow	3	2	—
Wrist	—	—	—
Hand	1	2	1
TOTALS	53	63	40

	1951–2	1952–3	1953–4
All Contusions	193	169	129

LACERATIONS AND ABRASIONS

	1951–2	1952–3	1953–4
Foot	6	3	2
Lower leg	33	13	11
Knee	59	71	100
Thigh	22	18	17
Trunk	5	1	—
Chest	3	1	—
Head, face	11	15	9
Arm	11	11	12
Hand	7	4	5
TOTALS	157	137	156

It is roughly possible to compute 'injury expectancy' but as yet records have not been maintained for a long enough period to decide whether or not it is feasible to place any valuation on this assessment. In order to work out the chart it is necessary to assume that each game a man plays represents one exposure to injury thus the following figures are evolved. In the first chart given, an injury is only tabulated if of sufficient severity to cause a game to be missed

	1951–2	1952–3	1953–4
Total numbers of players used throughout the season	84	93	94
Total number of exposures	1903	1815	1826
Total number of injuries causing one or more missed games	33	42	36
Average numbers of exposures before injury	57·66	43·22	50·66

However when every injury however minor that is sustained by the players during the course of the season is considered the figures alter astonishingly From a state where a player is theoretically able to play between 43 and 57 games before he receives an injury serious enough to cause him to

miss a game, he is injury prone almost every third game in which he plays! Thus —

Total numbers of players used throughout the season	84	93	94
Total number of exposures	1903	1815	1826
Total number of ALL injuries received during the season	627	785	489
Average number of exposures before ANY injury	2·98	2·35	3·74

The great disparity between the two sets of figures indicates that the immediate inception of skilled and accurate physiotherapy with frequent treatment sessions each day, greatly limits the gravity of injuries, besides prolonging the ultimate playing life of the athlete.

With an average full time professional playing staff of 36 men, the total numbers of players missing one or more games through injury each season was as follows —

1951–2	1952–3	1953–4
18	27	23

	1951–2	1952–3	1953–4
Total numbers of games played	1903	1815	1826
Total numbers of games missed through injury or illness	90	109	95
Percentage	4 5 per cent	7 per cent	4 80 per cent

Interesting, although of debatable reliability and value, is the relationship between the athlete's playing position in his team and his injury potential. Figures from Spanish football sources show in percentage form the injuries sustained by individuals in the team —

	Per cent
Goalkeeper	13·64
Right back	7 43
Left back	8 47
Right half	9 14
Centre half	8 57
Left half	7 52
Outside right	7·61
Inside right	8·95
Centre forward	11·90
Inside left	8 57
Outside left	7·04

Similar statistics maintained during three seasons with an English professional club do not entirely conform to the Spanish figures, thus —

	Games missed
Goalkeeper	4
Right back	8
Left back	13
Right half	2
Centre half	11
Left half	4
Outside right	Nil
Inside right	13
Centre forward	8
Inside left	7
Outside left	8

These figures show each occasion on which the player in the specified position missed a game through injury it is not known if this is the same basis on which the Spanish figures were obtained. Obviously if each injury received, however minor were noted, the records would be considerably altered.

An attempt was made, over a three year period, again at Southampton, to investigate the age of the athlete and its effect on his injury potentiality Players were graded into three groups Group A under 25 years of age Group B between 25 and 30 years of age Group C over 30 years of age. Over a three year period, the players fell into the three groups in these average proportions Group A 35 per cent Group B 46½ per cent Group C 18½ per cent.

The injury incidence in relation to these age groups was —

Group A, 19 players missed 78 games
Group B 28 players missed 165 games
Group C 9 players missed 42 games

It does not appear as though age has a great deal to do with injury propensity from these figures at least not in the world of professional football A marked factor however, is the fact that the older player is more conscientious in his attitude towards treatment when injured. This is possibly because of his mature experience, whereas the younger player fails to realize the importance of prompt and adequate treatment. This is sometimes a mixed blessing as the younger athlete, viewing physiotherapy as a novelty tends to abuse the facility

The more fit an athlete may be the less likely he is to be injured the older player lacks the time to acquire the increased fitness he needs, hence he may lack the required standard of fitness required to fight off injury

CHAPTER II

THE PREVENTION OF INJURIES

It appears to be generally accepted that the work of the physiotherapist only commences when the patient is actually in the department, suffering from some sort of medical or surgical condition capable of improvement by means of physical medicine. In so far as the world of sport and medicine is concerned this attitude is not only outmoded but is totally incorrect—cause is equally as important as effect. Perhaps only in sport and in industry is the physiotherapist in a position to influence or affect the individual's propensities towards injury because until they walk, limp or are carried into the department, the worker in hospital has never set eyes upon the patient. Whereas in sport and industry the physiotherapist is working constantly with a large number of people, most of whom he knows personally and has a fairly good idea of their mental reaction to an injury

Consequently it is correct to assume that it does lie well within the power of the physiotherapist working with football, cricket, or other sports clubs to carry out certain measures to ensure that injury is kept down to a level where it represents a greatly reduced nuisance both to the man and his club The man attempting to treat amateur athletes seeing them but once weekly and with little control over them is in a slightly more difficult position, but can exert sufficient control over their pre injury habits to reduce the incidence of trauma. This is done by means of example, in that the injured man is told just how he received his injury and how it might have been avoided. The temporary loss of income is more than offset by the increased deference and heightened reputation of the physiotherapist in the eyes of those people for whose welfare he is partly responsible.

Obviously all men and women who participate in arduous and competitive sport are likely to sustain trauma at some

time or other These injuries can either begin long before the athlete kicked the ball, ran a lap, or played a set of tennis—they probably began with an insignificant occurrence of a momentarily painful nature which rapidly subsided, but later revealed themselves as relatively serious injuries Usually the condition rapidly worsens through neglect or ill treatment—the aim of the medically qualified physiotherapist being to by pass these factors. On the other hand, the injury may commence in a spectacular fashion with the breath taking clash of hardened bodies, or with a violent fall to earth during the course of a game.

Experience has shown that, with adequate supervision and foresight, a large proportion of sports injuries can be prevented or minimized. Injury is the occupational hazard of sport and physical fitness and training are its direct opponents, few factors being of more importance in the question of injury prevention. If those responsible for that side of sport carry out their job satisfactorily backed by the correct medical supervision making possible the early inception of suitable treatment when injury occurs, then most of what can be done has been done.

The great importance of physical exercise and training lies in the fact that by carefully graduated training it is possible to develop the muscles to a stage of actual energy production more than three times the normal rate. At the same time there will be a 400 per cent increase in the number of capillaries and a 100 per cent increase in their size Bodily fitness is attained by training, the aims of which are to be light and agile, to be able to perform movements with economy of effort, and to have complete control over the entire body Training develops strength, speed, agility skill endurance, flexibility, balance, improves reaction times, and controls the body-weight. All these factors have obvious connexions with injury in that lack of them invites ill-controlled movements and actions leading to muscular and ligamentous strain. In other words, the part played by fitness in the fight against injury lies in that it causes the muscles to possess tone and strength sufficient to support the joints on which they work, and to protect them from stress and strain.

Sports will be played more successfully, with less fatigue and reduced chance of injury, if greater strength and endurance are developed, because, as has already been said the value of muscle power developed by training is inestimable in the prevention of injuries. Therefore, to increase the power of the main muscle groups prone to injury before the actual playing season commences will go a long way towards combating the soft tissue injuries so prevalent in sport. Pre-season remedial type exercises to increase the strength of the supporting muscles and ligaments of the knee and ankle, the hip and lumbar regions the arms and shoulders should be devised for inclusion in the pre-season training programme of the athlete. They may also in a slightly modified form, be included in his training programme throughout the season.

Muscular strength can only be increased by the muscle contracting against a degree of resistance calling forth maximum effort. This resistance can be either in the form of weights, springs, or other artificial means, or by way of manual resistance. As the average system of prophylactic physiotherapy as this may be termed, will be carried out by a number of athletes of a club or team carrying out their mass training it is not always possible for sufficient equipment to be maintained to enable large numbers to use it simultaneously Thus it may be necessary to fall back upon the natural form of resistance—that provided by the men themselves. This manual resistance can take the form of the men working in partnership alternately performing the exercise or supplying the manual resistance. This system has its disadvantages and difficulties certain rules must be observed, two main rules being —

1 The resistance must be given smoothly from the beginning to the end of the movement.

2. The resistance should diminish gradually from the beginning to the end of the movement, as muscles are capable of exerting their greatest force when they are fully extended, their force lessening as they shorten.

As the players concerned become fitter and therefore less injury prone, it will be necessary to include some form of progression in the tables of exercises. The two simplest methods of carrying out progression in such a scheme of

prophylactic physiotherapy is, firstly to increase the number of times that each exercise is carried out, and, secondly, to increase the speed at which it is performed. The majority of exercises are normal items from the average physical training session, it is therefore possible for the table to be used as the preliminary physical training work out before beginning more strenuous or specific training To obtain the utmost benefit from this system it is essential that the players are made to warm up before commencing the exercises, otherwise it is extremely possible that we may create the injuries we are seeking to prevent.

The greatest threat to such systems of exercise is undoubtedly that of monotomy it is therefore proposed that four or so laid down tables of exercises be used, being changed daily Such tables are given below as examples and may be amended or altered as circumstances dictate.

TABLE I

1 *Rhythmic Exercise* —Feet astride jumping, with arms swinging sideways.
2. *Breathing Exercise* —Any deep-breathing exercise, preferably with arms being used also
3 *Foot and Ankle* —With partner alternate pick-a back, heels raise and lower
4. *Groin* —With partner—alternate crook legged sitting, resisted knee inpressing and outdrawing.
5 *Hamstrings* —High kicking at outstretched hand, using alternate legs.
6 *Game* —Cockfighting in pairs—this game involves all above groups.
7 Breathing Exercise.
8. *Knee* —With partner, standing facing each other with hands on each other s shoulders, full knees bend, straightening against other's resistance
9 *Abdominals* —Neck rest lying, touch alternate knees with elbow of opposite side.
10. *Lumbar* —Hewing (arms above head with fingers linked, forwards and downwards movements as though hewing with a two-handed axe)
11 Breathing Exercise.
12. *Hip Flexors.*—Back to-back wrestling
13 *Hip Extensors* —Standing with back to wall, backwards pressure with alternate heels.
14. *Shoulders* —Press-ups
15 *Neck* —Lying wrestler's bridge.
16 *Team Game* —Dodge and mark, etc.

The initial rhythmic exercise is inserted in order to create a need for oxygen, as a breathing exercise is far more effective when this situation applies. The games are inserted to break the monotony and as a reward for hard work!

Sports will be played more successfully, with less fatigue and reduced chance of injury if greater strength and endurance are developed, because, as has already been said, the value of muscle power developed by training is inestimable in the prevention of injuries. Therefore, to increase the power of the main muscle groups prone to injury before the actual playing season commences will go a long way towards combating the soft tissue injuries so prevalent in sport. Pre season remedial type exercises to increase the strength of the supporting muscles and ligaments of the knee and ankle, the hip and lumbar regions the arms and shoulders, should be devised for inclusion in the pre-season training programme of the athlete. They may also, in a slightly modified form, be included in his training programme throughout the season.

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TABLE IV

1 *Rhythmic Exercise*—Running on spot with high knee raising
2. Breathing Exercise
3 *Foot and Ankle*—With partner hands on each other's shoulders, resisted heels raise and lower
4. *Groin*—Crook sitting, self resistance to inward drawing of knees.
5 *Hamstrings*—With partner one forward lying resisted flexion of knees.
6 *Game*—Sit in hurdling position (one leg stretched forward the other stretched sideways at right angles, and bent to a right angle at knee). Rhythmic trunk pressing downwards to forward leg with opposite hand moving backwards.
7 Breathing Exercise.
8. *Knee*—Long sitting legs crossed at ankles straight leg raising
9. *Abdominals*—Long sitting alternate toe touching
10. *Lumbar*—Hips firm, stride standing trunk rotation.
11 Breathing Exercise
12. *Hip Flexors*—Lying, bicycling
13. *Hip Extensors*—Standing with back to wall, backwards pressure with alternate heels.
14. *Shoulders*—With partner resisted punching
15 *Neck.*—With partner resisted movements of head, with hands clasped behind each other's necks
16 *Team Game*—Through-end round relay—two teams with each man numbered ball out at front. As number is called man runs forward, collects ball, and dribbles it down line. Taps it through legs of first man, dribbles it around second man and so on, until team is complete ball and man returning to place.

The stresses and strains of sport are abnormally great, and to protect a joint against these strains requires exceptional muscles. Normally strong muscles can be strengthened considerably with the expenditure of only a small amount of effort and time. It is essential, however that these exercises should be supervised in an enthusiastic and confident fashion failing this much benefit will be lost. Although it is reasonable to expect that the strengthening of relative muscle groups will reduce the incidence of injuries, no system can be an infallible guarantee that this will be the case. This prophylactic system or technique is no more, or no less than an effective method of building up muscular power; to fail to build up that power is to fail to provide the player with one means of protection against injury

Whether or not it is physiologically correct, experience has shown that muscles regularly stretched to their fullest extent

TABLE II

1 *Rhythmic Exercise.*—Four skip jumps on spot, then one jump etc.
2. Breathing Exercise.
3 *Foot and Ankle*—With partner who holds outstretched foot whilst man pivots on toes of other foot.
4. *Groin.*—Sitting with crooked legs, squeezing hand between knees.
5 *Hamstrings*—Lunging as in fencing
6 *Game*—Circle formation, human support, alternate man to lie hanging by hands, alternate leg raising and lowering
7 Breathing Exercise.
8 *Knee*—With partner, kneeling (sitting on heels), raising and lowering body against partner's resistance.
9 *Abdominals.*—Lying, both legs raising and lowering
10. *Lumbar*—Forward lying hands clasped behind back, head and shoulders raising
11 Breathing Exercise.
12. *Hip Flexors.*—Hips firm standing, drawing alternate knees up to chest.
13 *Hip Extensors*—Lying flat on back, pressing alternate heels into ground.
14. *Shoulders.*—With partner resisted punching (lightweights, middleweights, etc.)
15 *Neck.*—With partner hands clasped behind each other's necks, resisted forwards and backwards neck movements.
16 *Team Game*—Circle, with half class in middle, ball is thrown by outer circle men to touch inner men who then join outer circle until only one man remains.

TABLE III

1 *Rhythmic Exercise.*—Arms swinging upwards, forwards, sideways, and downwards rhythmically
2. Breathing Exercise.
3 *Foot and Ankle.*—Marching with body weight on outside borders of feet.
4. *Groin.*—With partner one to sit with legs outstretching, impressing and outdrawing against resistance.
5 *Hamstrings*—Arms linked, partners sitting back to back, rising.
6. *Game.*— Ski-ing —legs together and knees slightly bent, arms hanging loosely legs straighten and arms swinging rhythmically
7 Breathing Exercise.
8 *Knee*—With partner, shoulder support, one leg extended, heel raise and full knee bend on other leg—alternately
9 *Abdominals.*—Lying, alternate single leg raise and touch ground with toe, on other side of body
10 *Lumbar*—Forward lying, neck rest, head and shoulders raise, trunk turning
11 Breathing Exercise.
12. *Hip Flexors*—Lunge standing, downward pressure of rear leg.
13 *Hip Extensors*—Forward lying, partner to resist upward drawing of alternate legs.
14. *Shoulders*—Press-ups.
15 *Neck.*—Lying wrestler's bridge.
16 *Team Game.*—Circle with football lying in middle one man at time defends ball, outer circle men throw other ball at stationary ball—defender is out when it is hit.

TREATMENT STATISTICS

Season 1951–2

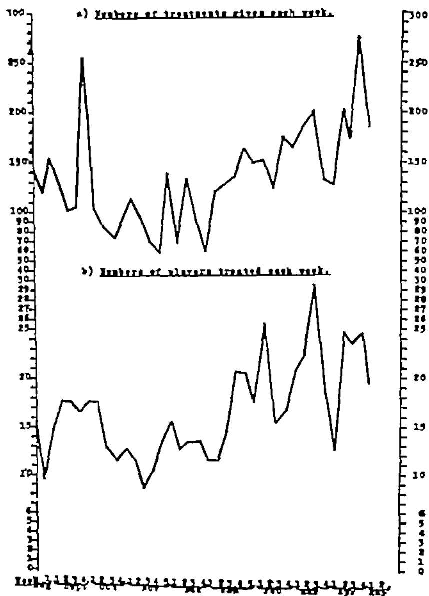


Fig 1

are more able to withstand the strains and stresses of sport. It can be assumed that in few cases in life, and that includes the world of sport, are muscles worked in other than their inner or middle ranges hence they are unaccustomed to sudden stretching to full range during moments of athletic emergency Daily exercising to ensure that the muscles of the legs, for example, are put through their fullest range plus a little overstretch, will enable the athlete to cope with this situation.

Throughout this chapter so far the relationship between fitness and injury has been constantly stressed it has been emphasized that injury potentiality rises as the standards of physical fitness descend. Taking, for example, the situation applying in the professional football club—statistics show that injuries rise to a peak during the first six weeks of the season. This is due to two factors—firstly that it takes the average player six weeks in addition to his four weeks pre-season training to attain a standard of physical fitness sufficiently high to fight off the less severe type of injuries. Secondly during this six week period the clubs are playing twice weekly thus giving double the opportunity for injury to occur whilst halving the time available for treatment. At the conclusion of this period the injury situation clears up considerably until after the Christmas period, when a strenuous programme of three games in four days is encountered, and the chronic type of injury begins to refuse to be quietened by treatment and requires rest. Obviously it is not always possible to nurse an injury over a long period, even with the most con scientious strengthening exercises and eventually the player has to be rested.

As can be seen from the accompanying graphs (*Figs* 1–3) the situation outlined above prevailed at the club under discussion. As there are no comparable records from any other professional football sources it is not possible to contrast this state of affairs with that applying elsewhere. The whole purpose of record keeping and statistics of sports injury treatment is to assess the frequency and cause of injuries, thus permitting the required measures to be taken to prevent them. Possibly the greatest attempts at statistics in this sphere are

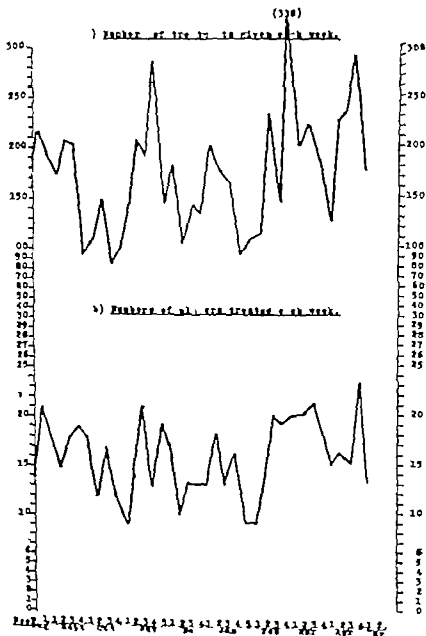

TREATMENT STATISTICS
Season 1953-4.
(318)
300
250
200
150
100
90
80
70
60
50
40
30
29
28
27
26
25
20
15
10
6
5
4
3
2
1
0

Fig 3

TREATMENT STATISTICS

Season 1952–3

a) Numbers of treatments given each week.

b) Numbers of players treated each week.

Fig 2.

possess a sense of judgement as to the gravity of the injury because athletes vary and, as in every other walk of life, some characters make a great deal of noise about a minor occurrence whilst the silent individual puts up with a considerable amount of discomfort in martyred quiet. The trainer and coach must have some form of training in first aid and an elementary medical knowledge, in order that he can safely assess whether to permit an injured man to resume play or to withdraw him from the team.

In just the same way the physiotherapist working with athletes must give them the impression that he is quietly confident, that he understands their game and the difficulties encountered therein. In fact, if the physiotherapist does not have this knowledge to some extent he will be greatly handicapped in his attempts to assess whether an injury will stand up to strains and stresses of which he has no personal knowledge.

The administrators of sport also must bear their share of the responsibility for injury prevention , this they do by means of careful supervision leading to the formulation of rules designed to head off dangerous practices Such rules include those which protect goalkeepers from being kicked by onrushing forwards regulations concerning the height at which a player is considered to be able safely to kick a ball, thus obviating head and face injuries through boots being raised too high, or from having severe lacerations due to the projection of nails from football boot studs. Boxing is alive to the dangers within the sport, as the recently formed rules covering medical examinations and the length of time required for a fighter to rest after having been knocked out in his previous fight. Obviously the system of having safety rules will continue in all branches of sport as various practices arise that constitute a danger to those participating

Recurrent injuries are the bane of the physiotherapist's life in sport, arising from original injuries that have been neglected or incorrectly treated, leaving a weak link in the chain of physical fitness. These chronic, painful and limiting conditions occur frequently in the ankles, groins, and knees constituting a problem in treatment that is difficult to answer In spite of the most conscientious physiotherapy it will often

those carried out by Thorndike at Harvard University and fully detailed in his admirable book, in which he constantly stresses that control of injury and the development of a team go hand in hand

The prevention of sports injuries provides an ideal opportunity for an outstanding demonstration of co-operation between the athlete, his trainers and coaches, the physiotherapist, and the doctors and surgeons connected with his club or organization Adequate medical supervision is essential both before and after injury, beginning with a pre-season medical examination. All men must be physically fit for the sport in which they intend to participate, medical examinations will weed out those who are unfit and, for that reason, a far greater injury risk. The examination should include a full history of past illnesses and injuries, with a complete test of the eyesight, hearing, heart, lungs, circulation, excretion, and central nervous system Annual chest radiographs will obviate any risk of lung conditions and are quite easy to obtain under the prevailing system of mass radiography

The man who acts as the liaison officer or the go-between of the athlete and the physiotherapist is the trainer or coach. He initially sees the injured athlete, and sends him into the treatment room. Even more important is the fact that the coach or trainer almost invariably witnesses the occurrence of the actual injury With sports injuries the history of the actual occurrence is of vital importance as many injuries can almost exclusively be diagnosed on their history It is therefore of great importance that the trainer and coach are educated up to a full understanding of the work of the physiotherapist and are encouraged to co-operate in every way Thorndike claims that the incidence of injury in sport can definitely be related to the training and years of experience of the trainer and coach, who must speak the same language as the men he is training who must be familiar with their game from a to z. He must be stern but just, have no favourites and by example must make the team respect both him and his judgements. The trainer must drill all the athletes under his control to report *all injuries, however minor because a small injury neglected* to-day can become the major injury of to-morrow He must

danger to the athlete carrying out his exercises The weights used in Progressive Resistance Exercises must be handled carefully as a 50-lb 'iron' boot used for quadriceps exercises will create a very severe injury if allowed to fall on the foot. Footwear is extremely important in sport an athlete who is allowed to wear boots of incorrect type whilst playing will obviously be wide open for foot and ankle injuries. In addition to this, ill fitting shoes and stockings, or unclean darned stockings and those with holes in them will cause blisters—remember that it is just as easy for an athlete to miss a vital game through a foot infection as through a torn muscle. It is a good idea to suggest to the soccer or rugger player that he should alter the usual arrangement of studs on the sole of the boot (usually they are in pairs at the front and rear of the sole) If the boots are equipped with one stud only in the front it will enable the player to pivot on the single stud, thus avoiding any fixation of the foot. A boot with two studs will catch in a tuft of grass etc. thus causing the foot to be fixed to the ground whilst the upper part of the leg is allowed to rotate upon the fixed foot. This, of course, provides the ideal situation for a meniscus lesion or ligament strain

One of the principal duties of the physiotherapist working in sport is to ensure that no man returns to active playing after an injury without being 100 per cent fit. This is by no means as easy as it sounds athletes are not the same as the normal patient, they have a certain degree of temperament, and the prima donna attitude is sometimes encountered. The amateur athlete will often state that he is free from pain and limitation, apparently completely fit in order that he can return to the game he loves whereas he is in reality far from physically fit. Others, for some ulterior motive of their own will claim to be far worse than they actually are lingering around the treatment room long after the injury has left little other than a vague nuisance value. Usually little other than common sense can be used to determine whether a man is able to resume his place in the team and during any sort of tests that may be carried out. Subsequently it is frequently noted that players collapse on their first hard tackle or complete the game in a state of limping agony Much of the guesswork

be found that it is necessary to have the athlete manipulated under an anæsthetic by an orthopædic surgeon thus breaking down the painful and limiting adhesions. No player with a medical history of such a weakened joint should be permitted to take part in a body-contact sport, such as soccer, rugger, ice-hockey etc, without adequate strapping to protect and support the joint, preventing aggravation of the condition But for the athlete or the physiotherapist to rely solely on this strapping is the height of optimism, the muscle strength and tone of those groups passing over and working the joint must be improved to a level even greater than that of the uninjured limb This is necessary because a physical deficiency has to be compensated for, and thus greater strength is needed.

In America it seems that ankles are strapped as a routine measure in most sports this is not the case in this country The procedure is debatable in its advantages, as it seems as though the strengthened ankles withstand the strain thrown upon them, but frequently pass it up to the unprotected knee. There can be no doubt that a supporting bandage of 2½ in. cotton applied in such a fashion that it supports the lateral ligament, the most frequently strained structure of the joint, will prevent a large number of sprained ankles. Following a sprained ankle it is essential that the joint should be supported in the correct fashion by a firm strapping support for a period of at least three months. Thorndike states Once a sprain, always a sprain the inference being that the area of a former lesion forms a permanent weak link. Recurrent injuries to the ankle are inevitable unless the athlete is encouraged to use this strapping support following injury

Equipment and environment form a source of potential injury and should be checked regularly to ensure that conditions of 100 per cent safety apply The rehabilitation of sports injuries frequently requires more strenuous forms of exercise than those normally used in hospital departments climbing ropes must be checked to see that their fastenings are in order, the padding of mats can slip away from certain areas, thus leaving a bare patch with hard floor immediately underneath and the floors of some treatment rooms and gymnasium are polished until they resemble a dance floor—this gives rise to subsequent

than its uninjured counter part on the other side of the body As an example, in the case of an injury to the knee-joint the main principle of treatment would be to maintain the strength and tone of the quadriceps. By means of weights attached to the feet it is possible to test that muscle group the uninjured limb being tested first to ascertain the maximum amount of weight that it can cope with ten times in succession The injured leg is then tested similarly and should not be considered fit for active sport until it can lift at least as much, but preferably more, weight than the uninjured leg The reason for this test is that the injured leg has obviously to compensate for the period of disability and resulting weakness and consequently it needs more power to do this

8 *Functional Tests* —This part lies more within the trainer or coach s duties but the physiotherapist obviously has more than a passing interest in it. The athlete should be put through a searching and thorough test on the field, he should be made to sprint, jog trot, run a figure-of-eight course in alternate directions turn rapidly on a sudden word of command, swerve jump and generally go through the normal movements of the game in question. Any signs of pain or limitation rule him out instantly It is far better that the injured part should break down during a test than during the actual game.

One factor concerned with these functional tests with which the physiotherapist must concern himself is that of warming-up a frequently neglected but vital process in the fight to prevent sports injuries. The physiotherapist must satisfy himself that the athlete who has until recently been under his charge for an injury is not permitted to commence any form of strenuous functional test without adequate warming up Otherwise the athlete will very likely quickly return to the treatment room! A large proportion of muscular strains can be directly attributed to the fact that the athlete has commenced his sudden action in a cold condition, so that his muscles lack the suppleness required to fight off strain and so give way The comparison can be made when one considers the engine of the motor-car the intelligent owner of which allows the engine to run-over on a cold morning before engaging the gears He does this because he knows that overnight the oil in the engine

can be eliminated by means of a planned routine, strictly followed, and carried out in the order given below —

1 *Appearance*—Contrast the injured part with the un injured limb, observe if there is any swelling or œdema, uneven contours pitting breaks in the skin, etc. Test the part for warmth, which denotes some form of inflammation.

2 *Everyday Function*—Before the player is actually tested his normal everyday movements should be observed, un obtrusively if possible. Watch for a limp notice how he ascends and descends a flight of stairs, how he sits and rises from a chair It is almost always possible for the trained eye to detect a guarded movement or a carrying of the injured limb The man is not conscious that he is being observed and subsequently is not on his guard to give the impression of fitness.

3 *Questioning*—By means of clear-cut questions and answers it is often possible to assess the athlete's degree of physical fit ness Few athletes will answer Yes to the outright question Do you consider that you are fit to play? if there remains a doubt in his own mind

4. *Pain*—On movement and to palpation or pressure. Pain on movement persisting after the man has adequately warmed-up denotes a persistence of a certain degree of injury It is often found that the injured area will remain tender to palpation for a considerable period after the injury has cleared up sufficiently to allow the man to play

5 *Passive Movements*—Instructing the patient to remain limp and not to resist, put all the muscles and structures around the injury to their fullest degree of stretching There may be slight pain on extreme movement, but a greater degree of pain or pain on movement in a small range shows that the injury remains in a dangerous condition.

6 *Active Movements*—Tell the patient to move the injured part, and at the same time apply some slight resistance to the movement. It is possible in this way to test all the muscle groups, both prime movers and antagonists, thus speedily discovering if an injured area remains.

7 *Resistance Exercises*—Before an athlete can be considered 100 per cent fit to resume, the joint or muscle that has been injured must be brought to a point where it is actually fitter

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has become thickened, the gentle-running in has the effect of lowering the viscosity of the oil by circulating it throughout the engine, thereby warming it and making it liquid. By preliminary exercises the blood is circulated throughout the body and the muscles become warm and supple, thus resisting tearing when put to stress. Body temperature rises in proportion to the intensity of the physiological work performed, the higher body temperature furthers the reaction speed of the chemical and physical processes forming the foundation for greater evolution of energy which in turn is responsible for greatly increasing the activity of the body

CHAPTER III

EXAMINATION AND DIAGNOSIS

FOR practical reasons it is essential that the physiotherapist should be capable of competently diagnosing the average sports injury as many of the treatments recommended are initially in the nature of first-aid. Subsequent treatment will, of course, be carried out under the supervision of a doctor, who will also make his own diagnosis of the injury

In many sports injuries the length of the disability period depends almost entirely on the speed with which initial treatment is given. The physiotherapist, therefore, should be capable of recognizing the more common injuries of sport, and of knowing the initial treatment, so that the athlete has every chance of making as quick a return to the game as possible. This being so he should have a routine system of examining all injuries so that he can form his own idea of the diagnosis and subsequent treatment, subject to the check of the doctor who later sees the patient.

As speed is vital, it is essential that the physiotherapist's diagnosis must be as near the mark as possible, otherwise the essential immediate treatment would be incorrect and valuable time lost, both at first and in the later stages of the treatment. It is well known that the diagnosis of soft tissue lesions leaves much to be desired, that certain conditions have been given labels which, by reason of their compactness, serve some sort of purpose, whereas other titles give little aid and some of them are positively misleading This chapter, therefore, attempts to set out in a simple fashion the outlines of a system of examination of the more frequent types of sports injuries so that a rapid and reasonably accurate diagnosis can be obtained. In other words, an attempt is made to discover the origin of pain by mechanical means of passive and voluntary movements which reveal the anatomical site of the lesion

The eventual discovery of the site of injury is directly due to the information gained by observing the type and direction of the movements which cause pain or are obviously weak. This is not hard to do because all Chartered Physiotherapists have a working knowledge of muscle action sufficient to enable them to formulate a routine for each joint, and experience in the performance of diagnostic movements is soon acquired. The eventual aim must be a diagnostic technique adapted to the conditions prevailing in the sports world, taking into consideration the different physical and mental background of the athlete. It must be designed to yield detailed knowledge of the lesions under consideration and to lead on inevitably to their speedy routine of treatment.

The method must be logical in its approach and accurate in its results, so that the affected structure is clearly defined and the position of the lesion within that structure well marked. The first requirement is to ascertain the tissue affected and the precise part in which the lesion exists. To arrive at such a localization requires the active co-operation of the injured athlete in that he is asked to state which movements hurt and which are painless—in sport this factor does not possess as many difficulties as that encountered in other spheres, because the physiotherapist frequently knows his man personally through long acquaintance. The next step follows automatically—what is the pathological nature of the injury and what logical developments can be expected.

The injured limb or joint is put through all the normal movements possible, in a voluntary passive and resisted fashion. If the movements show that the lesion is in a contractile structure such as a muscle group, it is possible to work out tests to elicit which of the several muscles is involved, and sometimes even the actual part. If the movements show the lesion to be in non-contracting tissue it must be ascertained whether the injury is involving many of the structures composing the joint, or only a single ligament. When the injury is not so recent, in that the athlete was injured a few days previously it is helpful to find out also by these means just how far the injury has progressed, as treatment obviously differs for acute and subacute or chronic conditions.

The history of the condition is extremely important and should be investigated in detail so that the events which led up to the appearance of the pain are known, together with its initial location later siting and its reaction to rest or exertion besides endeavouring to find out the type of pain concerned Inspection reveals much such as abnormal posture, wasting of muscle, deformity, guarded positions in which the injured limb is held, etc. Palpation reveals degree of effusion and tender areas, besides defining the limits of the lesion When required it is useful to have one's results checked by means of injection of local anaesthetic into the point of origin of pain if the correct site is chosen the pain will disappear whereas injection into an incorrect site will give no appreciable lessening of pain.

The deeper one s investigations into this vital facet of accurate diagnosis the more one realizes that every road leads to Rome. By that is meant that the system of discovering the site of the lesion, evolved and published by Dr James Cyriax, appears to be almost foolproof in its value when applied, not only to general soft tissue lesions but specifically to those injuries of sport. Little, if anything can be added to that already written on this subject of accurate diagnosis by Dr Cyriax, and study of his technique in this field is almost imperative for the physiotherapist working with athletes.

The knee joint sustains more injuries than almost any other part of the body For this reason, it is intended to use this joint to illustrate the system of examination necessary in order that the correct treatment can be carried out. As with every other sports injury the mode of examination comes under specific headings (1) History (2) Visual and palpable examination (3) Presence of pain (4) Diagnostic tests (5) Movement of muscles working on the joint, active passive and resisted.

1 **History**—This must be as complete as possible, and must include the following —

a Exactly how it occurred with patient demonstrating the incident as far as possible.

b Has the injury occurred previously?

c Has the knee ever "let the patient down"? Has it ever locked? Has there been any noticeable effusion in the past? The significance of these questions lies in the fact that an old injury that frequently recurs indicates a possible meniscus lesion or an incompletely healed ligament strain. The sensations of "letting down" and locking tend also to indicate a meniscus lesion. The presence of effusion shows that there has been some actual trauma, such as a contusion, twist, or wrench, whilst continued effusion recurring frequently denotes an internal derangement of the joint which has not been satisfactorily cured.

2. Examination.—Seek for signs of effusion, swelling, and bruising. Make a comparison with the opposite joint, thus bringing to light any marked differences. Test for effusion by means of such tests as "floating" the patella, or by pressing down on the suprapatellar pouch whilst lightly placing two fingers one on each side of the patella—the forcing of the fluid down into the joint from the suprapatellar pouch will cause the fingers to be gently forced outwards. It is also possible to detect effusion by means of fluctuation, the fluid being gently moved from one side of the joint to strike lightly against the hand or fingers on the other side of the joint.

3. Pain.—This is of the greatest importance when examining an injured knee, as it is sometimes possible accurately to diagnose the site of injury by means of a resisted extension of the joint. The patient is asked to straighten the already flexed knee against the physiotherapist's resistance; the movement sometimes causes pain at the actual site of the lesion. Pain can be caused in two ways: (*a*) When it is caused by the patient's voluntary movement; and (*b*) When it is caused by means of palpation. The latter will denote injury to any of the more superficial structures of the joint, such as the fibular or tibial collateral ligaments. Pain on palpation at the joint line can indicate an injury to one or other of the menisci (the joint line of the knee is a line drawn 1 cm. below the lower limit of the knee-cap and continued around the knee at the level of the upper margins of the tibial condyles).

4. **Diagnostic Tests**—By means of these it is almost certain that the operator will be able to detect the particular structure and type of injury sustained. For example, in order to test the medial or lateral ligaments, the knee should be 'sprung' so as to put the suspected structure on the stretch, thus causing pain. A similar springing movement in an anteroposterior direction will elicit pain in the rear of the joint over the popliteal space, thus indicating that there is a strain of some fibres of the rear portion of the capsule. A straightening of the knee with the foot turned outwards that gives pain on the medial aspect of the joint or an audible 'click' or 'clunk' denotes a lesion of the medial meniscus, whilst a similar movement with the foot turned inwards to cause pain on the lateral aspect of the joint indicates a lesion of the lateral meniscus. This opinion, of course, is also reinforced by a history of locking, effusion, etc., although it is rare that all the text book signs and symptoms exist together. A large proportion of injuries to the knee joint of a relatively severe nature give indications initially of a cartilage lesion but by a process of elimination within a few days of the original injury it is invariably possible to discard this diagnosis, if it is proven false.

5. **Movement of Muscles.**—Examination of the voluntary, passive, and resisted movement of a muscle group hardly applies in the case of the knee-joint, but is essential in the case of a soft tissue lesion. The muscular connexion when dealing with an injury to the knee-joint is, of course, that of the quadriceps muscle group. No injury to the knee joint should ever be examined without a considerable amount of attention being given to this vital muscle group. It is quite possible for a serious injury to the knee to occur solely because of quadriceps insufficiency, a condition giving rise to gross instability and a long train of injury. It is very important that this fact should be conveyed to the patient, and there are few injuries to the knee joint, other than those of a bacterial type, that will not benefit immeasurably from a progressive course of quadriceps exercises.

If the physiotherapist carries out this system of examination conscientiously and efficiently he can hardly fail on its

conclusion to have a very complete picture of the cause, type, and nature of the injury If possible, it is a good idea to have cards printed for each of the major parts of the body, with specific headings, thus at the completion of the examination a written 'picture' is in front of the physiotherapist. Without an accurate idea of the injury it is impossible to treat it correctly

CHAPTER IV

METHOD OF TREATMENT

EXPERIENCE with a professional football club, a county cricket team, a speedway team, an ice-hockey team, a leading athletic club, two clinics specializing in the treatment of athletic injuries, a rehabilitation centre, and four London hospitals gives rise to a disturbing realization—the realization that whilst techniques have considerably improved since Galen was team surgeon to the gladiators of Marcus Aurelius in 131 A.D., the facilities appear to have diminished! No sports club has its own doctor exclusively treating its athletes, whilst only about five professional football teams employ a chartered physiotherapist to minister to their valuable stars.

This leads to the inescapable conclusion that facilities for the treatment of injured athletes are far from perfect. The physical medicine department of a hospital obviously has too much on hand to undertake the full rehabilitation of a reasonably fit young person who is probably fit enough to work but not to kick a ball or run a lap Rarely does the department possess staff experienced in the priority forms of treatment required by athletes, owing to the average physiotherapist infrequently seeing an injury in its acute stage.

Possibly the rehabilitation centre possesses the greatest promise in this field the active approach, with emphasis on progressive exercises is very suited to the treatment of sports injuries, and residential or all-day routine provides the perfect high pressure atmosphere (*Fig* 4) Unfortunately, these centres are few and far between and do not cater particularly for sports injuries

In sufficient numbers, clinics specializing in the treatment of recent injuries could go a long way towards solving the problem It would be essential that they should be staffed by physiotherapists experienced in treating recent injuries and

conclusion to have a very complete picture of the cause, type and nature of the injury If possible, it is a good idea to have cards printed for each of the major parts of the body, with specific headings, thus at the completion of the examination a written 'picture is in front of the physiotherapist. Without an accurate idea of the injury it is impossible to treat it correctly

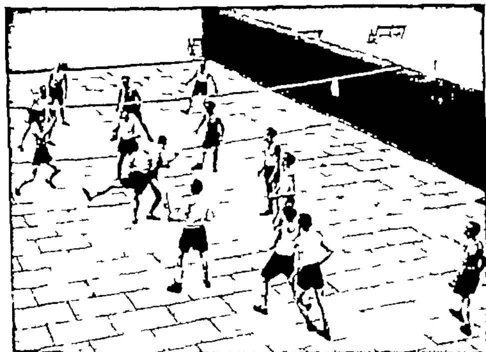


Fig 4.—Rehabilitation in special centres The rest of the day is spent in recreations—volley ball is useful for every type of injury (From SIR R. WATSON JONES's *Fractures and Joint Injuries* published by E. & S Livingstone Ltd.)

possessing the correct approach, but this would be difficult because there are few opportunities for physiotherapists to learn the necessary techniques Such establishments should adopt the policy of 'Home Treatments', because the majority of athletes are young and not particularly wealthy and they are able to attend only once or twice and must be instructed as to their role in treating their own injuries at home.

In speedway racing there is one particular factor which is an advantage—every rider has to be insured before he can race. In the event of an injury, the rider receives a set sum each week that he is out of action and 15 per cent of the total sum he receives is set aside for treatment fees. This enables an adequate treatment routine to be followed under private auspices. Actually on the track premises few facilities exist, apart from a doctor in attendance and a number of first aid men.

As befits a sport steeped in tradition, county cricket until recently has had little time for such modern refinements as physiotherapy Possessing little cash in hand and with slender hope of obtaining any, the average county team uses marquees and pavilions that were built before W G Grace was in his prime. Hence facilities are of the most meagre type—the simplest operation, such as massaging a bowler's shoulder or legs, necessitates the herculean task of clearing a table (always too small anyway) of a dozen huge cricket bags, autograph books, and tea cups, etc. The physiotherapist is advised to adapt local facilities as advantageously as possible and rapidly to retire with his patient to his own clinic when possible. A portable infra red lamp and a well-equipped first aid kit, together with a blanket to lay on the already mentioned table, constitutes about all one can use in the average cricket pavilion.

Ice hockey and athletics similarly possess no facilities, nor do players have to insure themselves against injury hence a major crisis occurs when cash is required to cover injury treatment.

In view of the present financial crisis in the world of professional football there is little hope of the existing facilities being improved. Possibly twenty out of the existing professional clubs could afford a full time physiotherapist, and about five of that twenty already possess one, these being clubs

which realize that to avail themselves of adequate medical resources is merely an enlightened economic proposition But as the wealthiest sport in this country it is from professional football that we can anticipate the advance of experienced and qualified medical facilities

Until the end of season 1954/5, when financial difficulties intervened, Southampton Football Club had a medical team working with exceptional smoothness. Available were honorary surgeon, orthopaedic surgeon, E.N T specialist, neurologist, and a club doctor, whilst a chartered physiotherapist worked full time in the club s well-equipped treatment room. By means of extensive pre-season medical examinations carried out as a routine on all players (*Fig* 5) it was possible, over a four year period to weed out at least three players whose life expectancy would possibly have been affected had they continued to play professional football Annual chest radiographs and periodical dental check ups were also carried out.

All physiotherapy and rehabilitation of injured players took place on the club premises, whilst minor surgery was carried out, under sterile conditions during the course of an actual match, if required. A log book was completed daily giving details of all treatments and particulars of lost training and games missed through injury Ultra violet light sessions were carried out thrice weekly and records kept as to dosage etc. Each player had a card, duly completed and kept in a card index system giving details of his injuries and his treatment by this means it was possible to carry out prophylactic physiotherapy ensuring that the player regularly suffering from any particular type of injury at a specific part of the season was physically and mentally strengthened to fight off that injury

The numbers and types of different treatments given during the three years under review are given overleaf and make interesting reading

The whole policy of treatment at Southampton Football Club revolved around the precept Treat and Train —a system which ensures that an injured player is encouraged to carry out whatever training he can manage at the same time as he is under treatment. In this way he is almost ready to resume his place in the team when his injury is cleared up

MEDICAL HISTORY

Name .... Married or Single ....

Date of signing as a Professional .... Date of birth ....

Height .... Weight ....

Previous Illnesses ....

....

Present state of health ....

General appearance and physical development ....

....

Heart and Arteries .... Pulse-rate ....

.... Lungs ....

Abdomen ....

Central nervous system ....

Vaccination ....

Ears ....

Nose ....

Throat ....

Eyes ....

Limbs: Knees ....

....

....

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Ankles ....

....

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Feet ....

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MEDICAL REPORT

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Fig 5.—Medical History card as used by Southampton Football Club completed by the club doctor following annual medical examination. (For the reverse side see overleaf.)

	1951–2	1952–3	1953–4
Number of occasions on which players were treated	2612	2275	3125
Number of different treatments given	5192	5412	6085
X-rays given	20 (8 men)	35 (13 men)	18
Sutures	14 (4 men)	14 (4 men)	7
Operations	4 (4 men)	9 (9 men)	2
Fractures and dislocations	5	6	6
Illnesses	3	10	2
Outside Medical Facilities utilised			
Number of visits by the club doctor	206	246	197
Players examined by Club orthopaedic surgeon	10 (18 occasions)	16 (28 occasions)	8 (19 occasions)
Types of Treatment given			
Remedial exercises	1365	1140	1417
Massage	1042	1033	1052
Short wave diathermy	748	778	764
Radiant heat and infra red	240	167	98
Dressings	198	246	382
Supporting strappings	132	338	496
Protective strappings	78	122	286
First-aid treatments	77	141	299
Faradism	57	40	22
Kaolin poultices	54	65	61
Wax baths	53	11	64
Rubber and felt paddings	51	99	76
Contrast baths	45	40	107
Galvanism	40	41	39
Manipulations	30	27	65
Penicillin injections	4	23	40
Foam baths	3	2	—
Aspirations	1	1	1
Ultra-violet light	720	972	960

instead of having to make up for lost training Through the use of this routine the days of full training lost in the three years under review was only 3 per cent. The large numbers of strappings and paddings listed are due to players being fixed up so that they could train with a minimum of pain and discomfort during the actual disability period.

This routine of treat and train is hallmarked by the club honorary orthopaedic surgeon, Mr H H. Langston, F R.C.S

It is right to stress the importance of treatment with training because not only does this mean that the player s general physical condition is not allowed to deteriorate as a result

of his being off all exercise except that of a remedial nature, but it does mean that a player's morale is maintained. He is also encouraged to regard an injury as an incident in his playing career which will temporarily limit his activities, but will not permanently put him out of the running. It is most important to stress the psychological angle and value of this treatment-with-training system as well as its value in relation to maintaining a man's general fitness. Obviously, this type of combination of treatment and training is only possible where a club employs a fully trained physiotherapist, and one could not countenance it on medical grounds unless the combination of treatment and training were under the care of a qualified physiotherapist working in close conjunction with the club medical officer.

From the statistical point of view the value of this system is apparent from the following figures —

	1951–2	1952–3	1953–4	
Available training days	5580	6336	5973	days
Training missed entirely	270	193	83	days
Light training only possible	150	203	107	days

The medical personnel working in sport and, indeed, throughout the world of physical medicine, are often puzzled at the amount and type of exercise required to give results, which are not able to be quantitatively evaluated anyway. Progressive resistance exercises, as so adequately described by Thomas E. Delorme and Arthur L. Watkins in their most interesting book *Progressive Resistance Exercises*, appear to be the answer. This type of exercise has a sound physiological basis, in that strength can only be augmented by muscles contracting against a degree of resistance calling forth maximum effort. This resistance must become progressively greater as contractile power increases, because muscles driven to a standard of work beyond that which is easily performed will inevitably respond by hypertrophy. This standard of work can either be in the form of moving a light weight rapidly or a heavy load slowly, but the resistance (i.e., the weight) must be progressively increased.

It is not yet clear as to what constitutes the optimum resistance/repetition combination for building up muscles and the optimum frequency for exercises. Weight lifters

Diagnosis of Injuries	Physiotherapy

enables the patient to bear weight immediately, thereby making possible early movement, with all its advantages. However, it may retard the essential element in the complete return of full function—namely, the absorption of all fluid resulting from the injury Mr John Charnley has written that in some cases the pain which develops after the anaesthesia has passed off is much worse than the original pain, and for that reason oily solutions such as proctocaine are not recommended Smillie recommends an interesting treatment for strain of a ligament of the knee-joint in which the area of the lesion is injected and then placed under compression by means of a block of orthopaedic felt and elastic adhesive plaster Generally speaking it would appear that the theoretical arguments claim a vicious circle of pain and vascular spasm broken by anaesthesia whatever the success of the injection, the general idea of promoting early function is highly commendable and is probably the most important factor

Complete physiological rest for an athletic injury is unthinkable, although rest from excessive weight bearing with the injured part kept gently moving by means of muscular contractions and non weight bearing exercises is essential. There is a school of thought which advocates that absolute rest will succeed where vigorous physiotherapy fails If any injury other than those listed below fails to respond to treatment rather than to complete rest it is necessary to look for some other cause for the impaired progress, such as septic foci within the body Complete rest is only called for in the following instances —

1 Complete rupture of a nerve.

2. For two or three days following dislocations

3 Elbow joint injuries, particularly dislocation for fear of myositis ossificans.

4. Fractures—the site of the fracture is completely immobilized but outlying muscles are moved as quickly as possible.

5 Certain cases of tenosynovitis, especially if they involve extensors of the wrist.

Balance plays an important part in the treatment of sports injuries, far reaching effects following the muscular imbalance which takes place as the result of injury The athlete is a

know that there is an optimum rate and duration of work at which strength increases most rapidly this is generally considered to be ten repetitions carrying the heaviest load that can be lifted this number of times, resting and repeating With a systematic programme it will be discovered that the load must be increased at regular intervals.

The principal objections to this form of exercise do not apply to otherwise hardy athletes, who are surely the most fitted people in the community to benefit by such vigorous methods. A most satisfactory practical demonstration was afforded by the professional football player who was returned to first-class football within four weeks of a meniscectomy during the last few days of his rehabilitation he was lifting a daily total of 2½ tons on his injured leg!

Athletes possibly more than any other section of the community, are favourably impressed by any form of treatment which will give rapid or almost instantaneous effects. Of all the weapons in the armoury of the physiotherapist there is none that will give these seemingly miraculous results more quickly than that of manipulation. Many of the conditions confronting the physiotherapist in sport are eminently suitable for manipulating—a speedy method in a sphere where speed is the essential factor The manipulative methods outlined so competently by Dr James Cyriax are completely suitable for use by the physiotherapist and should be learnt and practised until competence and confidence are gained.

The injection of anæsthetic has a large place in the diagnosis of many sports injuries, and an equally prominent part to play in the returning of the injured athlete to his team. It would seem a reasonable theory that the injection of anæsthetic into a minor muscle injury can only aid in the natural healing processes, but it appears to be an equally reasonable supposition that to inject anæsthetic into a badly torn muscle is to greatly enhance the chance of the muscle tearing even more because the pain factor has been masked. Thorndike states that the treatment made popular by Leriche, if given immediately after a sprain occurs, may be valuable particularly if it contains adrenaline to control hæmorrhage. Dr Pepper medical officer to the Arsenal F C says that anæsthetic injection

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CHAPTER I

TECHNIQUES OF TREATMENT

EXPERIENCE in treating the injuries of sport has shown that there are two methods of treatment depending largely on the type of athlete being treated —

1 Those athletes who can receive unlimited treatment under this heading come mainly those players attached to professional clubs and the top-grade amateurs.

2. Those athletes who are unable to attend other than infrequently for treatment either by reason of lack of time or shortage of money

It will follow therefore, that any form of treatment technique evolved must be divided into one system embracing treatment unlimited by lack of time or finance, and another method by means of which the athlete must be satisfactorily cured with short term sessions of treatment and home exercises. Each of these methods has a completely different approach, as indeed has the whole subject of athletic injury treatment when compared with physiotherapy as carried out in hospital or in the normal private practice There is no miraculous method used in treating athletic injuries no revolutionary techniques or secret potions—short wave diathermy is given to the man injured on the football field in exactly the same manner as it is given to the elderly lady hurt when slipping on an icy pavement. The different, speedier results obtained are reached because of an approach widely differing from that of the normal physiotherapist, owing to the operator possessing a high sense of priorities, a marked degree of urgency causing as many as possible of the twenty four hours of the day to be utilized in getting his patient fit enough to return to his place in the team.

To cover satisfactorily this approach technique thus giving it a label in order that it may be discussed and debated

trained person with a highly developed sense of balance and he moves with marked economy of effort. Any factor which results in these faculties being impaired will result in muscle imbalance and loss of athletic efficiency The chief cause of muscle imbalance is pain, which causes protective movements in order to avoid the pain reaction. This, in turn, sets up minor soft tissue injuries caused by muscles and other structures being stretched or contracted through being used in an unaccustomed manner

Muscular imbalance must be avoided and care must be taken to ensure that the athlete does not acquire incorrect patterns of movement or posture. Thus, in addition to the priority restoration of muscle balance it is essential that the muscle groups involved are strengthened by means of exercises, ideally of a progressive resistance type.

To conclude, in a report to Southampton F C. Mr H H. Langston, F.R.C S said The physiotherapist's emphasis on the personal element in treatment, with detailed knowledge of each player's make-up is important. I also think the weight laid on preventive physiotherapy will pay big dividends if adopted in the club training programme.

the author has entitled the two already mentioned systems the 'Pressure Technique' and the 'Home Technique' The former system, the Pressure Technique, is only possible where the physiotherapist concerned is employed on more or less full time work with a sports club, such as a professional football cricket, or ice hockey team. Under these circumstances he is able to treat his patients at any time he so desires and for any length of time, and thus has an unrivalled opportunity for prolonged, intensive treatment. This pressure system was originally evolved when it was realized that of the ten or twelve hours of each day during which the injured player was available, only about 10 per cent of that time was utilized in treating the player if normal hospital or generally accepted practices were followed. Hence a concentrated technique was evolved in which the player s whole waking existence was devoted to planned activities scheduled to return him to active play as quickly as possible.

Let it not be thought that this technique means that the injured man lolls comfortably on a massage plinth for lengthy periods of each day, being heated by short wave diathermy or infra red lamps, massaged for hours at a time, and generally treated in passive fashion. On the contrary the player is almost forcibly encouraged to realize that his progress depends largely upon his own physical efforts, and the treat and train policy mentioned elsewhere in this book controls his whole régime of treatment. In the professional club the player is encouraged and aided by being in company with other team mates, either injured or fit as the case may be, thus providing a certain spirit of competition and high degree of incentive In any sphere of physical medicine it can truly be said that the physiotherapist cures no one—he merely aids them to cure themselves

To elaborate on the pressure technique —it means that the injured man is given as many sessions of treatment and exercise as can conveniently be fitted into the day the usual programme consisting of a treatment in the morning, another one in the afternoon, and a third in the evening, although in cases of extreme urgency it has been the practice of the author to give a treatment at 9 a.m. another session at 11 a.m. further

sessions at 2 p.m. and 4 p.m., and a final one at 7 p.m. A procedure which has been found to be essential to the success of this system is that of a planned and laid down system of immediate treatment when the man is injured. By that is meant a systematic routine carried out thoroughly immediately the player is either helped to the touchline for rapid first aid or carried into the treatment room being completely unable to continue the game. It may consist of merely a pressure bandage, or prolonged application of cold compresses, chipped ice, etc., but it should become an automatic routine for every type of injury likely to be encountered on the sports field.

This preliminary foundation adequately carried out makes it possible to build up the pressure technique system of treatment and enables the physiotherapist to get away to a flying start. Of course, in the desire for haste it must not be overlooked that it is almost invariably necessary for there to be a twenty four hours period between the conclusion of the immediate treatment and the onset of the pressure technique. The author has been experimenting with a cut down period of twelve hours and whilst results have been encouraging it is necessary to carry out further tests before hallmarking the shorter period of rest—that is of course rest with non weight bearing exercises or exercises of a mild active nature. This period of rest is to allow hæmorrhage to cease within the injured tissue, and hæmatoma formation to take place in a controlled manner owing to the application of pressure bandages and sponge-rubber padding etc.

As has already been stated a thorough planned exercise routine is essential, playing an even more important part in the treatment of sports injuries than do the passive forms of treatment. This is carried out under the supervision of the physiotherapist and also at home, under the patient's own steam. It has been noticed that this method of treatment causes an astonishing improvement during the first two or three days following the injury and that the patient is intensely optimistic and works very hard. Unfortunately his ardour is sometimes dampened and allowances must be made by the physiotherapist for a 'static' period which seems to occur

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To elaborate on the 'pressure technique'—it means that the injured man is given as many sessions of treatment and exercise as can conveniently be fitted into the day, the usual programme consisting of a treatment in the morning, another one in the afternoon and a third in the evening, although in cases of extreme urgency it has been the practice of the author to give a treatment at 9 a.m., another session at 11 a.m., further

sessions at 2 p m and 4 p m, and a final one at 7 p m A procedure which has been found to be essential to the success of this system is that of a planned and laid down system of immediate treatment when the man is injured By that is meant a systematic routine carried out thoroughly immediately the player is either helped to the touchline for rapid first aid or carried into the treatment room, being completely unable to continue the game. It may consist of merely a pressure bandage, or prolonged application of cold compresses chipped ice, etc., but it should become an automatic routine for every type of injury likely to be encountered on the sports field.

This preliminary foundation adequately carried out makes it possible to build up the 'pressure technique' system of treatment and enables the physiotherapist to get away to a flying start. Of course, in the desire for haste it must not be overlooked that it is almost invariably necessary for there to be a twenty four hours period between the conclusion of the immediate treatment and the onset of the pressure technique The author has been experimenting with a cut-down period of twelve hours and whilst results have been encouraging it is necessary to carry out further tests before hallmarking the shorter period of rest—that is, of course rest with non weight bearing exercises or exercises of a mild active nature. This period of rest is to allow hæmorrhage to cease within the injured tissue, and hæmatoma formation to take place in a controlled manner owing to the application of pressure bandages and sponge-rubber padding etc.

As has already been stated a thorough, planned exercise routine is essential, playing an even more important part in the treatment of sports injuries than do the passive forms of treatment. This is carried out under the supervision of the physiotherapist and also at home, under the patient's own steam It has been noticed that this method of treatment causes an astonishing improvement during the first two or three days following the injury and that the patient is intensely optimistic and works very hard Unfortunately his ardour is sometimes dampened and allowances must be made by the physiotherapist for a static period which seems to occur

on about the fourth day and lasts for about three or four days, during which time the injury only slightly responds to treatment and shows little sign of improvement over the degree reached on the third day Following this static stage, the injury makes rapid strides and responds very well to treatment. During the whole period of injury it is the practice of the author to support the damaged tissue by means of strapping support and sponge-rubber or felt pads, thereby enabling the athlete to move around in as little pain as possible. This has both a physiological and a psychological side to it, in that the patient is able to retain his highly developed sense of athletic balance during the injury period without placing undue strain on other soft tissue structures through incorrect gait or posture, and he is also encouraged to assume that his injury is not as severe as he first thought because he is able to get around in almost normal fashion. To the highly-strung athlete the last factor is one of great importance and can *have considerable bearing* on the *length of his disability* period.

There are, however certain conflicting factors that will be encountered in using the pressure technique the main one being of a minor nature but which can completely halt the whole system if not carefully studied. It is that of skin soreness possibly the sole limiting factor due to the superficial tissues becoming inflamed and irritated by the constant application of heat and massage, usually of a deep friction type. Obviously once a break or a blister occurs it is not possible to continue with the application of passive physiotherapy To combat this difficulty the area of the lesion should be very carefully treated after each session with calamine lotion, Caladryl, or a good skin food. Another precaution is to shave the hair from the area of the lesion, thus avoiding folliculitis through the hairs being torn from the skin by the intensive treatment. Two very real conditions that must be guarded against when using pressure technique are those of post traumatic para articular ossification (Pelligrini-Stieda's syndrome) and that of myositis ossificans traumatica. In the case of the former condition it has been stated that the clinical symptoms giving rise to the possibility of this condition are common to most

injuries (J Kulowlski*) Smillie, however, states that the conclusion is not correct in that only a small proportion of sprains progress to the production of heterotopic bone although all sprains and direct contusions localized to the femoral attachment of the medial collateral ligament of the knee joint are potential forerunners of the condition, and that it is merely a matter of achieving an accurate diagnosis of the condition This ossification of a hæmatoma, usually at the femoral attachment of the ligament, a particularly opportune site for the development of such a pathological process is greatly encouraged by massage and passive movements in any form. A patient with any such ligament sprain which fails to make the rapid progress to recovery expected, becoming worse rather than better after a period of three to four weeks' treatment, with severe pain weakness, and gross limitation of flexion, should be strongly suspected of suffering from this condition.

There is apparently no known predisposition on the part of any athlete to acquire myositis ossificans traumatica, the ossification of a hæmatoma, and McMurray has stated that no precautions will be of any avail if the patient has any tendency to the condition. If it is noticed that the contused area is not satisfactorily clearing up under normal treatment and that the range of movement of the joint concerned is progressively lessening, and that there is a palpable hard mass within the substance of the muscle, then myositis ossificans must be suspected and the necessary treatment instituted. Here again, this is a condition greatly aggravated by the continued application of heat and massage, and which has the added complication of being visible on an X ray film only after twenty-one days or so

No attempt has been made in this book to probe into the physiological disadvantages, if any of the pressure technique The system is put forward empirically having been tried, tested, and found to be extremely effective when carried out by physiotherapists who have undergone adequate, recognized training and who possess normal common sense. In support of the method, over a three year period the average disability

KULOWLSKI J (1942), Post traumatic para-articular ossificans of the knee-joint *Amer J Roentgenol.*, 47 No. 3 392

period for two of the most common sports injuries causing an enforced lay-off, is as follows —

a. Strain ligament of the knee—15 days total disability

b Strain anterior fasciculus of lateral ligament of the ankle —10 days

These periods, which are from the day of the actual injury to the day on which the athlete resumed playing, will bear comparison with any results obtained by other methods. Another factor giving support to the technique is that in the past there have been extremely diverse views on the optimum number of times on which treatment should be given, little of an authoritative nature having been put forward. Neither have there been any ideas propounded as to the length of time that an actual treatment should last, because it is the custom in most establishments to give short wave diathermy galvanism etc. in 15–20 minute doses. This being the case, surely it can be said that there is a definite case for experiments both in the number of treatment sessions during the course of a week and in the length of time for which that treatment lasts

One thing can be said in connexion with the pressure technique and that is that if the system is going to work, then it has more chance of working satisfactorily on young athletes than on any other section of the community There is an undoubted fitness foundation underlying the skill of an athlete in any sport, coupled with all the resilience and recovery powers of youth, that make these people the best possible material on which to work. In many cases they will recover from their injury reasonably satisfactorily without any form of treatment it is the job of the physiotherapist to reduce the time that they are out of action. In his book *Rheumatism and Soft Tissue Injuries* (Hamish Hamilton Medical Books) Dr James Cyriax says Rehabilitation can be pushed on too fast. Damaged joints possess a maximum speed of recovery under treatment that cannot be increased by yet more intensive treatment. Overhaste leads to a hot and painful joint which has to be rested for a few days before active treatment can be begun again. Again, the methods so signally successful in young and active patients recovering from fractures and orthopaedic

operations are not necessarily suited to the degenerative and rheumatic lesions of middle aged and elderly patients "

When considering the 'Home Technique' one must essentially review the types of patients that will be encountered such men as those connected with the local university, works teams, individuals from local clubs youth clubs, etc. All these sections of the sporting community have one thing in common—they lack unlimited financial resources for injury treatment. It is therefore imperative that they be spared prolonged and expensive treatment routines, their sessions must be cut down to a minimum whilst at the same time adequately covering the minimum required treatments As will be seen later the role of the physiotherapist almost approaches that of a supervisory capacity whilst the bulk of the work is carried out at home by the patient, who has previously been instructed and had the treatments and exercises demonstrated to him. Various difficulties immediately stand out when using the home technique, but none of them are insurmountable if the physiotherapist is prepared to impart some of his knowledge to be used possibly clumsily by the suffering athlete. First of all, the cases are rarely seen for at least twenty four hours after the injury has actually occurred and usually a far longer period has elapsed. The average athlete does not initially give an injury due importance he nurses it and attempts home treatments of an inadequate nature, finally coming along to the physiotherapist a week or so later when he finds the injury is not responding to his efforts This means, of course, that rarely have the necessary immediate steps been taken such as a pressure bandage, cold compresses or a supporting strapping Subsequently, the physiotherapist is usually treating an injury in a semi-chronic or at best subacute state.

The way in which this situation can be bettered is for the physiotherapist to project his personality and ability to the athletes and clubs concerned, so that they realize the importance of sending their injured men as soon as possible. As soon as it is realized that this practice will eventually save considerable time and money they will conform! Two other methods of persuading athletes to come along to the clinic

promptly are for the physiotherapist to explain the importance of the fact by means of lectures and articles in local sports papers etc. and for it to be made known that the clinic dealing with the injuries is holding a regular Sunday morning session for the express purpose of treating the injuries incurred on the previous afternoon—this service seems to be greatly appreciated once it is known.

When the patient has arrived, it is essential to explain clearly to him the nature and cause of his injury, with the added 'scare' of the prognosis should he not carry out the instructions given him Discuss the methods of treatment that you are going to use, explain the reasons for them, so that he goes away from the clinic fully conscious of his disability how to prevent it in future, how to treat it now, and just how long it is likely to keep him out of action. Thus he is fully encouraged to take the widest interest in clearing up his own injury Let the initial treatment be full and active to the point of vigour strap or support the injury so that he feels definitely improved when he walks away from the clinic—in this way he receives a big initial stimulation to encourage his further efforts Give him a concise plan of his home treatment, with each part adequately demonstrated so that there can be no misunderstanding If the injury requires heat before exercising then it can be applied by means of hot towels, contrast baths, or hot water bottles there must be definite times for exercise periods in which domestic facilities are utilized—such as flat irons for weights in resistance exercises the piano to be used in lieu of wall bars if the feet require anchoring, etc. *It is a good idea if the physiotherapist* can make himself available on the morning of the game in which the athlete is to return after injury during which he will carry out any supporting strapping or padding required. In this way the athlete is given the best possible chance of making the grade, and the physiotherapist's stock rises accordingly!

The primary aim of the physiotherapist working in the world of sport is to reduce, by all means possible, the length of the disability period incurred by the injured athlete, at the same time keeping within the bounds of physical safety and without adversely affecting the patient in later life.

Having established that primary aim an accompanying factor falls neatly into place in that the athlete who has been injured must not only be returned to the team with the minimum possible delay, but in the maximum condition of physical fitness so that he can resume his specific role in the sport concerned This factor is essential if only because the athlete requires an even higher standard of physical fitness than the other players because he has to compensate for his recent physical deficiencies

It is no use aiding the player to recover from an injury rapidly if he is permitted, during his disability period, to lapse into a state of bodily unfitness for active sport, through lack of adequate training, that will take two or three weeks to eradicate. Thus is wasted all the advantage of prompt efficient, and speedy treatment, and the end result takes as long as though no treatment at all were instituted

A system of training during treatment must be instituted, and the physiotherapist must appreciate that an essential part of his task is to ensure that the patient is equipped with the necessary strappings, paddings, etc. to enable him to cope with all possible training during the actual period during which he is also receiving treatment. Every step must be taken to give the patient the maximum possible degree of mobility during his disability period so that he can carry out whatever type of physical training is possible under the prevailing circumstances. This state is not wildly optimistic, the very nature of the high quality physical material represented by the athlete presents a basic standard enabling different methods and higher aims to be achieved than would be the case with the average type of hospital patient.

With this target in front of him the physiotherapist can go about his duty of ensuring that the player is theoretically fit to play at the same time as his injury is cleared up in the following fashion Working in close liaison with the trainer or coach, he will lay down a programme of training for his injured charge that will maintain strength and mobility in the unaffected muscle groups and joints, whilst not harming the injured area. The man with an injured foot or knee will carry out non weight bearing exercises in the gymnasium followed

by abdominal exercises and general body work. The man with the fractured fibula will report to the club at the same time as the uninjured players, he will change into his training kit or track suit just as they will do, and then will proceed to the gymnasium with them, where he will carry out the organized physical training class exercises as far as he is physically capable —following this class the uninjured carry out more specific practices of skills and techniques, while the injured man sits on a gym mat and carries out his toe, ankle, and knee exercises as prescribed by the physiotherapist. He is encouraged to regard himself as a fit man, but with a very temporary handicap which at the very worst, represents as only a small gap in his sports career

The footballer suffering from a cartilage lesion who has to wait a few weeks for a bed in the local hospital is in a slightly different position—he will get worse before he gets better He carries out everything that the other players do even to playing at half speed in practice matches, but in addition to everything else he is given a strenuous course of quadriceps strengthening exercises along progressive resistance exercises lines lifting totals of 2–3 tons a day on the injured leg Thus he is ensured of being in tip-top physical condition at the moment of under going the meniscectomy and the muscle strength and tone acquired render him a very good bet to return to the team with a minimum of delay following his post-operative rehabilitation.

Throughout all this treating and training it is evident that a strong psychological factor is present—the injured man is encouraged to regard himself as no different to his colleagues, he mixes with them and works with them instead of feeling a being apart, because *an injury to an athlete is a first-class* cause for self segregation from his fit colleagues. The athlete doing nothing other than a couple of hours treatment a day is encouraged to look around for sympathy he lapses into a state of mental apathy which requires a considerable amount of dispersal when the man is otherwise ready to play again. A perfect example of the uses of treating and training is that displayed in the treatment of a young footballer a very promising centre forward with an England B team cap

(*Case* 14) This man suffered a severe knee injury on Boxing Day, in which the lateral ligament of the joint was ruptured, with accompanying rupture of the anterior cruciate ligament. He was immediately placed in plaster-of Paris fixation from toe to groin, but on Dec. 28 (two days after his injury) he was ordered to report to the club as usual at 9.45 in the morning When he arrived he found his training kit laid out in its usual place, and he was treated by the trainers in the normal fashion and it was made quite evident to him that he was expected to take his part in the day s work in the usual fashion. When he had got over his initial surprise, he rapidly fell into the spirit of the situation, his recently-acquired depression and anxiety left him, under the influence of the trade talk and chaffing of his team mates. This procedure followed daily, with supervisory visits to the treatment room and non weight-bearing exercises demonstrated and explained to him for home performance. In five weeks he was considered sufficiently recovered by the club orthopædic surgeon to be relieved of the cumbersome plaster and an adhesive elastic strapping was substituted. This, of course, enabled him to carry out even more active work, so he progressed quickly never becoming bored or mournful, because he was kept too busy to have time to be either! In the first week of April just over three months after the original injury the man played his first game—a disability period of quite modest proportions when one considers the gravity of the injury

It was considered by the man himself and by all concerned in his treatment, that the rigid adherence to treat and train methods was mainly responsible for the success.

In conclusion, it is realized that it is not given to every physiotherapist to possess the necessary qualities of adaptability required either for work in the somewhat boisterous confines of a professional football club or the somewhat unorthodox athletes injury clinic. Problems are encountered which leave little time for cogitation, or even a quick glance into an anatomy book. For example, in a professional club it is customary for the players to arrive at 9.45 a.m. to begin training at 10 15 a.m., and finish at about 11 30 a.m.—at which time all the disabled players surge into the treatment room requiring

treatment—at the same time! Successfully to cope with this situation requires great tact and a certain amount of organizing ability

There is a certain lack of deference towards professional qualifications on the part of the patients, and the personal relationship between patient and physiotherapist is possibly of a higher standard of importance than in most other medical circles. The physiotherapist must be a likeable man, who speaks the same sports language as the men he is attempting to treat—to them, a friendly but knowledgeable approach counts for more than letters after one's name!

CHAPTER VI

INJURIES TO THE KNEE-JOINT

RESEARCH carried out at Southampton Football Club indicated that there were 769 recorded instances of injury during the course of a single season Of this number, 127 were to the knee-joint, whilst of the thirty different types of injury that were of sufficient severity to cause a player to miss one or more matches, ten were to the knee-joint. In football at least it would appear that the knee joint receives a larger proportion of injury than any other joint of the body

The construction of the knee joint on initial consideration would lead one to assume that it is one of the least secure joints of the body Various factors tend to make the joint seem to be insecure the amount of leverage that can be brought to bear upon it is considerable being formed as it is from the two longest bones in the body Neither do the surfaces of these two bones the femur and the tibia, seem to be particularly adapted to each other, consequently the joint possesses a very wide range of movement. However in reality the joint is one of the strongest possessed by man because of the powerful ligaments which bind it together Second to muscle tone and control in the opinion of many authorities these ligaments maintain the integrity of the knee joint, but in so doing are occasionally injured. Their inherent structural strength, however is demonstrated when one compares their incidence of injury with that of the menisci Minor injuries to the ligaments occur when strain is thrown upon them with muscles momentarily off guard, whilst complete rupture is encountered as a result of extreme violence

The greatest point in the athlete s favour when dealing with injuries to this joint lies in the prevailing high degree of quadriceps development attained by training and actual match play Following injury a certain amount of wasting of this muscle group is inevitable, but if time and continued physiotherapy

fail to cause the quadriceps to regain tone and volume as synovitis subsides, then it points to a mechanical defect and a detailed investigation is necessary It will be found that many signs and symptoms known to be a reliable guide in the diagnosis of chronic or recurrent internal derangement become misleading when applied to a recent, and particularly a first, injury to the knee Basic fundamentals in the treatment of knee joint injuries are that lateral strain must be avoided in either active or passive work, and that complete extension must be attained at the end of a contraction or movement.

Attention must be given in rehabilitation to all the muscles that work on the knee joint, the hamstrings suffer equally from atrophy of disuse following injury gastrocnemius is a knee flexor and becomes weakened, lessening in turn the strength of the ankle, thus further contributing to imbalance and knee strain. The synergist action of muscles in carrying out complicated automatic movements, such as walking or running, is definitely disturbed by the weakening of certain muscles following injury Such disturbances exist for long periods of time, resulting in uneven and eccentric muscle pulls this is a potential danger leading to further knee damage, particularly if there is a long disability period. Therefore, the hamstrings and all muscles actuating the hip and ankle should be exercised in addition to the vital quadriceps.

No injury to the knee joint should ever be examined without taking a considerable amount of notice of the standard and condition of the *quadriceps muscles. It is well known* that a disabling injury can occur solely because this muscle group lacks tone and volume a condition known as quadriceps insufficiency This muscle group is the key to the knee joint in that any lack of these qualities will cause the joint to be inadequately supported, with subsequent insecurity when stress is placed upon it.

As outlined in a previous chapter it is essential that the physiotherapist confronted with an athletic injury has a system of examination, in order that he may be capable of arriving at his own diagnosis and instigating a routine of treatment. There is no variety of sports injury in which this applies more strongly than that of an injury to the knee joint.

TRAUMATIC SYNOVITIS

This is not a diagnosis, but the almost inevitable reaction to every acute knee injury, it is a sign that the joint has been injured. The resulting effusion usually appears within about six hours or so of the occurrence of the injury a more immediate swelling can indicate acute traumatic hæmarthrosis Allowed to form in an uncontrolled fashion, effusion will be extremely difficult to disperse and will frequently linger long after the underlying causative factor, the original injury, has cleared up

A large effusion is dangerous for a number of reasons—it increases the intra articular pressure causes distension of the joint capsule interferes with the venous and lymphatic circulation, sometimes produces spasm and contracture of muscle by reason of irritated nerve-endings, and allows fibrin to be deposited and organized (in those cases where blood is present in the effusion) possibly causing later adhesions and even loose bodies. It causes restriction of movement at the limits of flexion and extension the joint being retained in slight flexion because of the capacity of the capsule is greatest in that position. This causes the important vastus medialis to lose tone and volume through inactivity, with subsequent obvious adverse results.

Trauma will cause certain reactions in synovial membrane, the cells are provoked into increased activity causing them to hypertrophy whilst producing larger quantities of mucin. This forms one of the two component factors of an effusion, being accompanied by an exudate from the circulation which is responsible for the concentration of proteids and crystalloids noted in traumatic effusions The swelling of the effusion causes the suprapatellar pouch to be outlined in a horseshoe shape, and the patella may be floated off the femoral condyles. There is not so much acute pain as discomfort and a feeling of distension, sometimes aggravated by attempted flexion and extension of the knee joint.

Causes.—Tucker* lists the possible reasons for an effusion of the knee joint as follows —

* TUCKER, W ELDON (1933), *Injuries and their Treatment* 109. London H K. Lewis & Co. Ltd.

1 Irritation of the synovial membrane by the presence of a hæmatoma on the outside of the capsule.

2. Seeping of the serum into the supracondylar pouch.

3 Reaction of the synovial membrane to absorb a hæmatoma which has seeped through the tissues into the pouch.

4. The hæmatoma which has seeped into the pouch, causing a reaction of the surrounding tissues so that it can be absorbed.

Recent injuries of a twisting nature or involving hyper extension are frequent causes. Any injury of sufficient severity to cause a meniscus lesion will inevitably cause an accompanying effusion. The presence of the effusion alone is no indication that the meniscus has been torn, because it can easily follow any minor strain and twist, or particularly a direct contusion. But a meniscus lesion never occurs in the absence of an effusion at the time of the original injury this is also the case in such severe injuries as cruciate ligament rupture or a complete rupture of the tibial or fibular collateral ligaments.

Throughout this chapter the importance and urgency of adequate quadriceps exercises will be constantly stressed but without experienced supervision it is possible to cause an effusion because of over-severe demands made upon a joint that is recovering from trauma. On the other hand, an effusion is very often caused by reason of quadriceps insufficiency particularly marked on resumption of active exercise with this vital muscle group lacking adequate tone and volume. It will frequently be found that the apparently unexplained obstinate effusion of the knee joint, with no recognizable underlying injury is caused by quadriceps insufficiency and it will rapidly clear up with progressive and frequent exercise sessions using weight resistance.

Treatment.—The aims of treatment are obviously to first of all clear up the underlying injury causing the effusion, to re-establish a return of circulation for the blood and lymph, to restore the strength of the structures working on the joint so that it is adequately supported during movement—all of this after first of all having undertaken prescribed initial measures to control the size of the effusion.

1 Immediate Treatment —This consists of the laid-down immediate routine for specific knee injuries with a very

generous pressure bandage, and a back splint if the injury is considered sufficiently serious. For the first twenty four hours weight bearing is inadvisable, and after that in all possible moderation Complete rest in bed with regular quadriceps contractions against the pressure of the bandage and padding is a good start if it is at all possible

2. LATER TREATMENT —This will largely follow laid down routine for specific injuries, as it is useless to attempt to disperse an effusion whilst neglecting the underlying injury The actual treatment of a traumatic effusion to the knee-joint as such must therefore necessarily take place at the later stages of the rehabilitatory period, when the strain, sprain or contusion has been largely cleared up There is a period, however during the treatment of the original injury when specific treatment designed to affect the effusion specifically can be embodied into the scheme of treatment this usually occurs at the stage when pain and discomfort are reaching the point of being little more than of nuisance value. The treat and train technique when an effusion is present has to be modified so that the athlete does a minimum of weight bearing and must therefore largely consist of body exercises.

a. Pressure Technique —If an underlying injury is present treatment must be embodied in the general scheme, thus forming a complete and set routine carried out twice or thrice daily If treating an effusion on its own, four daily sessions of treatment are possible and should consist of the preferred passive treatment and a progressive scheme of quadriceps drill.

The author's *treatment of choice* consists of four sessions each day of hot water bathing carried out in the following fashion. The patient sits on the edge of a bath or on a specially constructed seat across the bath, with a large bath towel folded in many thicknesses around the knee joint, over which he pours hot water followed by cold water in the proportion of two hot to one cold. Using the folded towel it is possible to use water of a considerable heat this session lasts for twenty minutes, after which the knee is very carefully dried and powdered, as it is no use so irritating the superficial tissues that further treatment becomes impossible. The patient is then placed upon a plinth with the affected leg in elevation,

well supported by pillows, etc. and given half an hour's massage with a vibrator, interspersed with deep effleurage in a downwards direction. At the conclusion of this part of the routine, the patient lies in the same position for a further ten minutes carrying out quadriceps contractions. Next follows a planned and progressive scheme of resisted quadriceps exercises, using either the weighted sandbags and pulley system, or weightlifter's iron boots capable of having specific poundage added at will. Both of these methods possess the great advantage of being able to be made progressive because at all times the physiotherapist knows the exact poundage that his patient is lifting. The best results have undoubtedly been obtained when DeLorme's Progressive Resistance Exercises have been used. The patient wears a modified type of pressure bandage at all times when actually weight bearing in the form of a crêpe bandage with a sponge-rubber horseshoe giving pressure over the suprapatellar pouch (*Fig* 6). This has the advantage over elastic adhesive plaster in that the latter is impracticable when frequent treatments have to be given because of the irritation to the skin caused by removal so often.

Other forms of treatment consist of —

Faradism in elevation under the compression of a firm rubber bandage (*Fig* 7)

Quadriceps contractions in elevation, also with a rubber bandage.

Short wave diathermy given in elevation, with one malleable electrode placed below the popliteal space and the other just above the suprapatellar pouch, thus aiding in improving the local circulation, with subsequent added fluid dispersal.

All of the above methods of treatment must be accompanied by the massage, weight exercise, and supporting bandage routine already described.

b Home Technique.—When treating the part time athlete, who can only attend for treatment on two or three occasions during the week, different problems will be encountered. The first of these lies in the fact that rarely have the correct immediate steps been taken when the injury actually occurs: frequently not even a simple type of pressure bandage will have been utilized. Subsequently the injury is not in a

particularly happy condition and a lot of leeway has to be made up

In the case of the particular injury under review effusion of the knee joint, the swelling will usually be very much more marked and will have consolidated, so that thickenings are palpable around the borders of the suprapatellar pouch and the sides of the patella. The main impact on the injury will obviously have to be made by the patient himself under his own domestic circumstances. For that reason it is essential that the background to the injury is fully explained to him and that he is fully briefed as to the type and duration of his home treatment with emphasis on the increased disability period if he fails to carry out his part.

The treatment of choice remains as for the patient being treated under the pressure system with the possible exception that it might be found difficult to apply hot towels in the confines of the normal room or in private practice If this is the case short-wave diathermy is a very suitable substitute The patient should be instructed to apply some form of moist heat, by means of towels or hot-water bathing in his own home He should be given an easily applied form of pressure bandage and fully instructed as to its application as it will obviously have to be removed and re applied occasionally But above all he must be told the importance of quadriceps exercises and given a clearly listed series of progressive exercises for home work. His whole programme of exercise, whether of a non-weight bearing variety or light training will have to be carried out under his own supervision at home, with the treatment periods solely devoted to passive treatment.

The other alternative treatments mentioned under the heading of Pressure Technique can also be utilized, if desired. But the exercise programme is essential and must be carried out with any form of passive treatment. The whole routine is supervised by the physiotherapist, who regularly sees the injury and gives encouragement to the patient. This matter of incentive is very important, as it is not always easy for an athlete to carry out lengthy and often boring exercise routines at home after having completed a hard day's work. The patient is also relying on the physiotherapist to tell him when

it is safe for him to recommence playing having little other source of reliable information on this subject. It must also be appreciated that he will not be able to do as much preparatory training as the professional player consequently he must be prepared to be out of action possibly a little longer

In the experience of the author the average amateur athlete is so keen to return to his sport that he will sincerely and genuinely work his heart out at home doing exercises, using improvised equipment and Heath Robinson' type arrangements of slings and pulleys, etc. and has frequently to be restrained from playing too soon. Rarely does the part time player slack on treatment routines

Up to the present nothing has been said of one of the standard methods of dealing with an effusion—that of aspiration. This apparent omission is due to two factors first because it is not considered that it comes under the heading of physiotherapy being purely a technique to be employed by a doctor or surgeon. As physiotherapists, we are solely concerned with the pre and post aspiration treatment. Secondly if the injury is seen immediately after it occurs and pressure is applied at once, then aspiration will seldom be necessary For this reason, little aspiration is carried out in the circles in which the author works the usual case requiring this technique will be that of the part time athlete, and his own doctor will usually make the decision.

Millard and Winn Parry* carried out an investigation at three Royal Air Force Rehabilitation Units to determine the best method of accelerating the disappearance of an effusion of the knee. The 260 patients concerned were all young men in 91 per cent the effusion followed meniscectomy and in the remainder the cause was traumatic none were associated with any pathological condition. The patients were divided into six groups, all of which carried out intensive quadriceps exercises (knee flexion being prohibited) and remedial games, and certain additional measures, the nature of which differed from group to group were applied These are

* Millard J B., and Parry C. B Winn (1953) *Ann. physical Med* 1 156–162.

given below, with the average time taken for the effusion to disappear —

		Days
1	Crêpe bandage worn night and day	23·0
2.	Daily through and through constant-current galvanism	24 8
3	Back-splint and bandage day and night	9·9
4.	Back splint bandage and daily anodal galvanism	14 2
5	Confined to bed with back-splint and bandage	9 4
6	No additional treatment	23 3

The back splint used was a light metal splint applied posteriorly and extending from mid-calf to mid thigh , it was worn continuously day and night, not even being removed for exercise or games periods.

The crêpe bandage support did not appear tó accelerate the disappearance of an effusion, but the use of a back splint appeared to be of considerable value in this respect no further significant improvement being obtained by the addition of rest in bed. Absolute immobilization of the knee therefore, appears to be the most important measure in the treatment of these effusions, but this must be accompanied by intensive quadricéps exercises if recurrence is to be avoided

Certain salient points emerge from this investigation Primarily it is useless to attempt to treat an athlete who requires a quick recovery with these methods, mainly because it is insufficient to give other than a very heavy and intensified routine of quadriceps exercises following meniscectomy, and forbidding flexion and the wearing of back-splints etc., precludes this. In the experience of the author if the patient is given a really hard pre-operative period of weight exercises, for about 14 days at least, involving the daily lifting of up to 3 tons on the affected limb in repetitions of ten lifts, then the post-operative period will rarely be troubled with any extensive effusion. The case histories shown under the heading of meniscus lesions prove this point. The other principal point is the complete ineffectiveness of various electrotherapeutic measures so long beloved by physiotherapists and hospital departments. The authors of the investigation emphasize that both the electrotherapeutic techniques (details of which are given in the text) were carried out meticulously but in spite of this their ineffectiveness is apparent.

CASE HISTORIES

Case 1 —Professional footballer a centre half, received a severe blow on the knee-cap during a game, which greatly reduced his effectiveness for the remainder of the match A pressure bandage was applied after the game (a delay of about an hour from the moment of injury) The following morning there was extensive swelling around the whole joint, and an extracapsular hæmatoma was diagnosed. This was aspirated with very little success. Thrice-daily treatment was given, consisting of short wave diathermy and light massage, with non weight bearing exercises with one session of faradism under compression with the limb in elevation. The patient commenced light training in 9 days, when the effusion was considerably reduced, and played again in 15 days During the whole period of rehabilitation and training he wore a large crêpe bandage and sponge-rubber padding over the suprapatellar pouch.

Total injury period 15 days No training 9 days Light training 2 days Full training 3 days Missed 4 games (early season, 2 games per week)

Case 2 —A hockey player fell and strained the medial ligament of the right knee. There was some pain and limitation of movement with considerable effusion that evening No immediate treatment given. Knee pain and limitation cleared up in 14 days or so, but effusion remained. Patient first seen after three weeks, when effusion was marked and considerable quadriceps wasting apparent. Given hot towels and vibrator massage treatment, with home routine of exercise. In 14 days quadriceps apparently up to standard and effusion greatly reduced. Played badminton after ten minutes knee gave way and patient fell, but with no increase of effusion. No indication of any underlying meniscus lesion, but failure of joint to stand up to slight strain gave rise to suspicions of lateral meniscus lesion. Continued heavy quadriceps exercises for further three weeks, using weights, and then recommenced playing hockey and badminton gingerly—no recurrence and has not had any further symptoms of trouble since (18 months)

Case 3 —Ice hockey player history of effusion, locking of joint, and giving way under stress Medial meniscus removed and routine rehabilitation measures gone through played again in seven weeks for two games when knee blew-up again. Routine measures of short wave diathermy faradism under compression, massage and exercises given knee apparently normal within ten days, but immediately gave identical symptoms on again playing hockey This went on for two months playing a game and then having a game off because of marked effusion, which responded to treatment rapidly Surgical exploration revealed portion of meniscus not

removed at first operation this was excised and post-operative rehabilitation routine followed Played again in 6 weeks with no further recurrence of trouble

LIGAMENT INJURIES

The ligaments of the knee joint are injured when strain is thrown upon them at a time when the muscles are not adequately supporting the joint, whilst extreme violence will completely rupture the ligaments It is acknowledged that the security of this joint lies mainly with muscle control and tone, but the various ligaments of the knee joints also play a very large part. The principal ligaments injured during the course of active sport are the medial and lateral collateral ligaments and the cruciate ligaments which will be dealt with in that order

INJURIES TO THE MEDIAL COLLATERAL LIGAMENT

The long anterior parallel fibres of the medial collateral ligament are frequently strained at their attachment to the femur with the joint in slight flexion a rotatory strain causes the damage In football and other body-contact sports it will sometimes be found that the injury is caused by a player falling against the outstretched and extended leg of another the resulting abduction strain even sometimes causing complete rupture.

The medial collateral ligament, when the knee is extended has a range of movement over the bones in an anterior direction whilst it lies posteriorly when the knee is flexed. When sprained, a few fibres of the ligament at the joint line usually rupture, giving rise to severe pain on the medial aspect of the joint. The injury is similar to that which produces a lesion of the meniscus and sometimes both structures are injured at the same time. The ligament sprain alone will not cause the joint to lock and it is possible for the injured man to continue playing although with difficulty

On examination there will be swelling over the medial aspect of inner femoral condyle, with a point of maximum tenderness at the point of attachment to the femoral condyle If an effusion is present with this tenderness it is not always easy to eliminate the possibility of a meniscus lesion. The

test for ligament strain is to 'spring' the joint (abduction) in extension, when pain will result at the site of the lesion. Extension with the foot rotated outwards will also sometimes give rise to the same symptom.

Treatment.—

IMMEDIATE TREATMENT.—Both Cyriax* and Smillie† advocate immediate injection of a few cubic-centimetres of anaesthetic into the site of the lesion. Smillie gives a technique for immediate treatment designed to return the player to the field at once, by means of anaesthetic infiltration, followed by the application of a 2 in. square of orthopaedic felt placed over the area, over which is placed a firm strapping of elastic adhesive plaster. This is claimed to promote rapid absorption of the products of injury by means of elastic pressure. An alternative method includes the use of an ethyl chloride spray instead of the injection, the area being frozen and allowed to thaw three times in rapid succession, after which the same procedure is carried out with felt and adhesive bandage. Both methods have been adopted with varying success by the author, who has been given cause to feel that the athlete's mental reaction to severe pain and the fear of a relatively serious knee injury destroy much of the efficiency of the methods.

If it is desired that the athlete returns to play, little better than these methods can be advocated. It has been found that a very heavy strapping almost precluding any flexion or lateral movement will enable the player to have a certain 'nuisance' value, whilst being able to move about with a minimum of pain and with little danger of aggravation unless further trauma is received.

The method of immediate treatment advocated to ensure the quickest possible results from later treatment is for the site of the lesion, and indeed the entire joint, to be given ice packs, continual bathing with ice water, or with ether meth. This should be given for about half an hour, after which a firm pressure bandage should be applied, and the man told to rest

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* CYRIAX, JAMES (1947), *Rheumatism and Soft Tissue Injuries* 282. London: Hamish Hamilton Medical Books.

† SMILLIE, I. S. (1946) *Injuries of the Knee Joint* 142. Edinburgh: E. & S. Livingstone Ltd.

the injured limb in an elevated position, whilst carrying out regular quadriceps contractions, for the next 24 hours

LATER TREATMENT —The aims of treatment are as follows —

1 To limit the extravasation of fluid into the tissues, and to aid in its eventual dispersal

2. To prevent valgus strain until pain and tenderness have subsided.

3 To maintain the strength and tone of the vital quadriceps group of muscles

The first aim is primarily dealt with by the immediate application of a pressure bandage, including sponge rubber cut to shape if considered necessary Later physiotherapeutic measures aid in fluid dispersal. The second is covered by raising the inner border of the heel and sole by about ¼ in. using sponge rubber or felt pads cut to shape. This measure is not really necessary until the patient commences weight-bearing The third is adequately covered by means of a regulated and progressive programme of weight exercises for the quadriceps (*Fig* 9)

A further essential part of the treatment is to restore full mobility to the ligament. The patient tends to rest the knee in extension in the early stages of healing causing scars to form which hold the ligament abnormally adherent to the bone This interferes with the anteroposterior movement of the ligament, which is distorted when the patient tries to bend his knee, thus causing limitation of flexion.

Whether the injury is treated by means of the pressure or the home techniques, it is essential that the injured athlete is prevented from limping around in an unbalanced fashion during his disability period, thus causing muscular imbalance and the acquisition of postural habits detrimental to later sports progress This is prevented by means of supporting strapping or bandaging with padding to allow movement without painful strain being placed upon the injured structure. This support should be placed on the athlete's knee by the physiotherapist after each treatment, and if it has to be removed at any time, the athlete should be clearly shown how to replace it correctly

1 *Pressure Technique*—At the conclusion of the initial 24 hours rest with-exercise period, the *treatment of choice* is as follows —

Hot towels (hot water poured over a thick towel wrapped firmly around the joint—two jugs of hot water to one of cold for half an-hour)

Gentle massage, designed to disperse effusion and generally mobilize the knee. Light frictions to the site of lesion.

Exercises, commencing with quadriceps contractions straight leg raising on to graduated knee extension with small weight resistance—this is made progressive as the lesion improves.

After 48 hours the hot towels are replaced by short wave diathermy, given mildly for 20/30 min., whilst the exercises and massage are increased in severity as the condition improves.

The above routine is carried out four times daily restricted only by the ability of the skin to withstand the heat and massage Dependent upon the same factor also is the application of a kaolin poultice to the lesion, with a pressure bandage to the knee for the period following treatment until bedtime.

Alternative treatments Initial anodal galvanism to the area for lengthy periods, such as 45 minutes, using large pads. Massage and exercises as above.

Histamine ionization to the site of the lesion, followed by massage and exercises.

Novocain ionization followed by massage and exercises.

The opening procedure of hot towels may be replaced by short wave diathermy

2 *Home Technique*—The idea here is to endeavour to formulate a system so that the lesion obtains as many periods of heat and exercises as the physiotherapist and the injured athlete can between them carry out. Thus the treatments given during the twice or thrice weekly treatment sessions should follow much the pattern set up above. The athlete must be instructed to apply hot towels hot water bottles, etc. himself at home, and should be given a thorough and concise exercise programme, showing necessary progression and using domestic alternatives to the weights, etc. available at the treatment room.

The supporting strapping and shoe padding is even more important when using the home technique, because the injured athlete is away from the physiotherapist's care for even longer periods and must be guarded against pain and possible imbalance. It is also essential that the athlete has explained to him the nature of his injury, the reason for the various forms of treatment, and, above all the part played by the quadriceps and the need for maintaining its tone and strength. Armed with this information, the athlete will invariably carry out at home every possible measure to accelerate his return to sport.

As explained in a previous chapter, the policy of treat and train applies here as with every other injury, and the athlete must be encouraged to undertake all possible forms of training compatible with his treatment routine.

When treating lesions of ligaments of the knee joint it is necessary to watch carefully for any signs and symptoms of post traumatic para articular ossification of the knee joint, the condition commonly known as Pelligrini Stieda's disease (*Fig* 10)

This is particularly applicable to lesions of the medial collateral ligament, and the deposit of heterotopic bone in the ligament attachment may be caused by any type of trauma which produces a suitable medium for ossification. Thus a localized blow at the attachment of the ligament or an indirect strain will be a possible forerunner of this condition. Any ligament lesion which fails to make the expected rapid recovery and seems to become worse over a period of about three weeks, with severe pain and limitation of flexion should arouse dire suspicion in the mind of the physiotherapist

Case Histories

Case 4.—Professional footballer in closing minutes of a floodlit game played under rather cold, night conditions, received a rotatory strain to the medial collateral ligament of right knee when his leg was locked with that of another player Treatment was instituted within ten minutes of the injury being received, an ice-pack being applied to the site of the lesion whilst the player had his showerbath. Pressure bandage was then applied, and rest with non-weight-bearing exercises for a period of 24 hours

At the conclusion of this period the lesion was found to be in such a promising condition that short wave diathermy and friction were

begun at once four times daily On the second day the player began light training of a non-weight-bearing nature.

Progressive resistance exercise routine was begun on the third day and up to 36 lb was lifted in five repetitions of ten.

Training but without sprinting and kicking was begun on the seventh day when passive treatment was cut down to twice daily

Weight exercises were increased after the seventh day so that up to 52 lb were being lifted three times daily five groups of ten repetitions making a total of 5 tons lifted daily with warming-up weights included.

Rehabilitation period was possibly lengthened because the player was in the veteran stage (over 34 years) and for ten days from the eighth day there was something of a static period.

Player began kicking and sprinting (completely full training) on the nineteenth day and played again 23 days after receiving the injury

Total disability period 23 days No training 4 days Light training 14 days Full training 4 days Missed 3 matches.

Case 5—*Professional footballer* received lateral ligament strain when opponent fell on outstretched leg and caused adduction strain. Injury relatively minor pressure bandage applied and kaolin poultice No training missed, twice-daily treatment of short wave diathermy *massage* and *weight exercises*.

Disability period 7 days Matches missed 1

Fourteen days later received rotational strain of same knee, resulting in minor sprain of medial collateral ligament. Pressure bandage applied, treatment as above. *Six days* disability period involving only 1 day's light training.

Disability period 6 days Matches missed 1

Ten days later again suffered from rotational strain which considerably aggravated any lingering lesion of medial collateral ligament. Considerable effusion, complicated by chronic infrapatellar bursitis intermittently treated. No training for 4 days hot towels and massage with exercises given three times daily Improved rapidly so that full training was undertaken in 10 days.

Disability period 16 days No training 4 days Light training 6 days Matches missed 2

This condition was possibly worsened by reason of the series of mishaps occurring during the last four weeks or so of a heavy eight months football season. The player involved was a hard playing wing half with a reputation for toughness and he was suspected of hiding previous symptoms or at least making light of them!

Case 6.—Professional footballer sustained lateral ligament strain in late August, whilst being tackled during a game. Injury appeared to be insignificant and was not reported by the player at the conclusion of the game subsequently no immediate treatment was given.



Fig 6.—Two stages in applying an elastic adhesive strapping involving the use of shaped sponge rubber to aid in dispersal of effusion



Fig 7.—Method of applying rubber bandage from below knee to groin when giving faradism under compression in order to disperse an effusion.

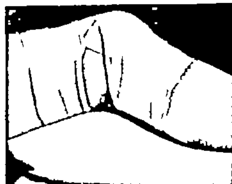



Fig 8.—Two stages of a knee strapping which leaves the posterior aspect of the joint free thus facilitating movement. Wearing this type of strapping it is possible for the athlete comfortably to play football etc. In the second photograph a crêpe bandage has been used for demonstration purposes, but in actual use the top strapping would be lastic adhesive plaster

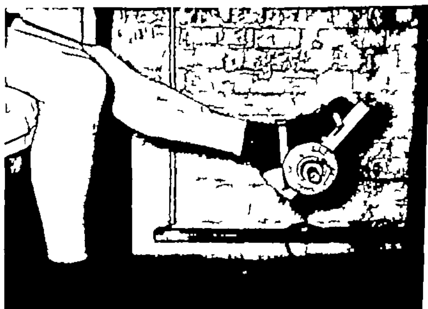


Fig 9.—Quadriceps exercises using weightlifter's iron boot.



Fig 10.—Post-traumatic para-articular ossification (Pellegrini-Stieda disease) showing visible swelling produced by heterotopic bone the site of the tenderness and the gross limitation of flexion. (From L. S. SMILLIE's *Injuries of the Knee Joint* published by E. & S. Livingstone Ltd.)

Next morning some effusion and marked limitation of movement was apparent, the patient complained of a feeling of general stiffness around the entire joint with palpable point of pain over femoral attachment of ligament. Given thrice-daily treatments consisting of short-wave diathermy massage and non weight-bearing exercises kaolin poultices and pressure bandage applied after each treatment Missed 1 day's training and then carried out light training mainly consisting of body exercises in the gymnasium This routine of treatment continued for 5 days with marked success the pain vanished but, although full movement was obtained he still complained of the feeling of stiffness. For this reason more general treatment to the joint was begun consisting of hot towels and mobility exercises. At the conclusion of the first week of the disability period he was able to carry out full training less vigorous kicking Played within 15 days.

Missed 1 full day 6 days light training Missed 3 games (early season period with 2 games per week)

Same player two weeks later received injury to medial ligament of same knee when he was fallen upon by opponent whilst he was lying on the ground with his leg outstretched. Continued match with difficulty received 45 minutes ice packs to knee after game no effusion until late that evening Pressure bandage applied and given 48 hours rest, with non weight bearing exercises

No training for 5 days then light training for 3 days during which period short wave diathermy massage and exercises were given twice daily Patient was in depths of depression and felt that his knee was finished

State of knee deteriorated after eighth day when it became stiffer and more painful. Saw consultant at local hospital who feared Pelligrini Stieda's disease but dismissed this next day when he carried out a manipulation under anaesthesia.

Patient was kept on weight exercises and wore a pressure bandage for next week, having been ordered 14 days rest from playing

At the end of that period began full training with no further trouble

Missed 5 games during disability period of 19 days

Case 7—International rugby player received injury to his right knee during a training period when he fell with his foot and lower leg trapped by another player The knee that was injured had previously received two relatively severe ligament strains over a two-year period.

A pressure bandage was immediately applied, but on the following morning considerable effusion was present. Twice-daily sessions of contrast baths with massage and non weight bearing exercises followed for four days resulting in some diminishing of the effusion although the joint remained stiff and painful Short wave diathermy replaced contrast baths for the next three days and the effusion

continued to disperse. But pain and limitation of movement remained, so that the doctor supervising the case sent the player along to an orthopaedic surgeon.

The surgeon took the view that the injury was a rotational strain of the knee, the main strain falling upon the lateral ligament and the anterior cruciate ligament. This diagnosis was more or less the same as had already been made on the day following the original injury There was no evidence of a meniscus lesion. On examination there was definite tenderness over the lower attachment of the external lateral ligament and pain could be produced in the same region if the knee was forcibly adducted. In the opinion of the surgeon there was some cruciate laxity although he considered that the player was a type with rather lax cruciate ligaments in any event, as there was a marked antero-posterior mobility present in both knees more marked in the right than left.

As there was some question in the minds of those treating the injury the joint was X rayed for signs of a loose body but no such evidence was revealed the two tiny calcified spots lying close to the internal femoral condyle were taken to indicate an old injury

The player was advised to carry out extensive quadriceps exercises and not to play for two weeks at least. Treatment was continued twice daily along the lines mentioned above and the man played four weeks from the date of the original injury

Total disability period 4 weeks No training 3 weeks Light training 2 days Full training 5 days. Games missed 4.

INJURIES TO THE LATERAL COLLATERAL LIGAMENT

The lateral ligament is a rounded band of comparative unimportance in stabilizing the joint, and is not subject to rotational strains because it is relaxed when in flexion. Varus strains are also less common because the inner surface of the knee joint is less exposed to knocks or strain.

Gross violence may cause a strain of the ligament or complete avulsion from the styloid process of the fibula, a case of which is reported later in this chapter A further aid in the protection of this ligament from injury is that it is reinforced by the iliotibial band and the biceps tendon.

Strain of this ligament is treated in much the same way as injuries to the medial ligament.

INJURIES TO THE ANTERIOR CRUCIATE LIGAMENT

Modern sport is a strenuous business and makes many physical demands on the athlete, demands which sometimes bring to light physical defects that render sport difficult

although hardly affecting the athlete in the course of everyday life. For example, little inconvenience is caused in civil life by fairly high degrees of instability of the knee joint, whilst strenuous sport may be quite out of the question Such an injury is that of a lesion to the anterior cruciate ligament, which is said by many authorities to rank second only in importance to lesions of the menisci as the cause of serious knee disability

This lesion has been considered in the past to be relatively infrequent, but modern sport is so arduous and tough that this assumption can be said to be erroneous. The physiotherapist working in the world of athletics will encounter many old cases with little or no history of rational treatment and will quickly be forced to the conclusion that the diagnosis of a lesion of the anterior cruciate ligament is rarely made at the time of the original injury In many ways this is not perhaps surprising as the degree of violence needed to injure this structure or to rupture it completely is of sufficient severity to cause considerable accompanying damage to the knee-joint, the resulting reaction to which will often mask the underlying and more serious, injury For instance, in cases where both menisci are torn there is invariably a complete rupture of the anterior cruciate ligament. The functions of this ligament and the complicated way in which the components of the knee joint work hand in hand, taken into consideration along with the mechanism of the actual injury points clearly to the fact that rupture of the anterior cruciate ligament alone is rarely encountered.

Brantigan and Voshell* suggest that the following functions may be attributed to the anterior cruciate ligament, given here in a much amended form —

1 Control *of forward gliding of the tibia on the femur* which forms the well known test for continuity of the ligament, when forward gliding is most obvious in flexion.

2. Control of lateral mobility in extension.

3 Control of lateral mobility in flexion.

BRANTIGAN, OTTO C and VOSHELL, ALLEN F (1941) "The Mechanics of the Ligaments and Menisci of the Knee Joint *J Bone Jt Surg* 23 44.

4. Control of rotation in extension.
5. Control of rotation in flexion.
6. Control of hyperflexion.
7. Control of hyperextension.

From these functions it can be seen that the ligament may be stretched or ruptured by the following *—

1. Hyperextension.
2. A force driving the femur backwards when the knee is in flexion with the tibia fixed.
3. Violent rotation.
4. Abduction, in which case the lesion must be accompanied by rupture of the medial collateral ligament and sometimes, in addition, by a depressed fracture of the lateral condyle of the tibia. A similar but less common mechanism is by adduction, in which case the converse associated injuries may be expected.
5. Dislocation of the knee.

In practice all the mechanisms given, but especially (3) and (4) may in addition produce lesions of the menisci. The frequent association with a medial collateral ligament injury is widely recognized.

To detect injury to the cruciate ligaments the knee should be bent to a right angle and the patient told to relax his thigh muscles whilst the foot is firmly fixed. Pressure in an anterior direction elicits pain in lesions of the anterior cruciate ligament whilst pressure applied posteriorly causes pain when the posterior cruciate ligament is injured (*Fig* 11). The range of anteroposterior gliding of the tibia on the femur should next be estimated and compared on both sides. As the anterior ligament assists in limiting extension confirmation may be sought by attempting the appropriate passive movement.

It is the custom in this country to treat lesions of the cruciate ligaments by conservative means, although it is doubtful if complete immobilization will cause all such injuries to heal. Watson Jones† states that satisfactory repair is possible if the

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* SMILLIE, I. S. (1946) *Injuries of the Knee Joint*, 106. Edinburgh E. & S. Livingstone Ltd.

† WATSON-JONES, R. (1943), *Fractures and Joint Injuries* vol. 2, 707 Edinburgh E. & S. Livingstone Ltd.

torn ligament is protected by immediate and complete immobilization Union may occur with a slight lengthening of the ligament, but this minor degree of instability is easily controlled if muscle power is normal The functional results are excellent and operative treatment is quite unnecessary The routine as specified by Watson-Jones is that of complete immobility of the joint with regular quadriceps exercise. A plaster cast is applied from toe to just below the groin, with the knee joint flexed 30° and the head of the tibia pushed backwards. This immobilization must be continued for not less than three months.

It will often be found that complete rupture of the anterior cruciate ligament is associated with a lesion of the medial meniscus. In this case treatment is usually operative and consists of excision of the meniscus, the anterior attachment of which is retained and used to repair the cruciate ligament when reinforcement is required Plaster is removed at the end of three months following this operation, when active knee-flexion exercises are commenced progressive quadriceps exercises must be carried out for at least three months. Operative treatment will rarely be carried out as a means of enabling the injured athlete to play professional football or serious sport. It is also ill advised where treatment has been delayed until there is gross laxity of associated ligaments, together with arthritis and inability to redevelop the quadriceps to a high degree of tone and volume.

It will generally be found that painful strain of the cruciate ligaments recovers eventually but often after many months. If the ligaments should be overstretched this will be permanent, but should cause little trouble if the quadriceps are adequately developed so that they provide an active stabilizer of the joint. In fact there is no injury of the knee joint in which the development of the quadriceps is of more importance, because it is the volume and tone of the extensor apparatus that will provide complete stability for the joint in the event of some permanent residual laxity of the ligaments.

As already stated the majority of lesions to the anterior cruciate ligament encountered by physiotherapists will be old injuries. There will be a story of an original injury often at

football and of a fairly serious nature. Subsequent symptoms will resemble those associated with a lateral meniscus lesion and will include recurring incidents resulting in momentary locking and effusion, coupled with progressively increasing instability of the joint. As the knee is constantly giving way sport will usually have been abandoned and the athlete will be in a depressed and sceptical mood concerning further treatment. The diagnosis may be checked by testing for the characteristic hypermobility of the tibia on the femur in a forward direction, coupled with quadriceps wasting It can therefore be seen that the diagnosis of old anterior cruciate ligament ruptures is not difficult, but unfortunately no known treatment can restore completeness of function.

The most severe factor associated with anterior cruciate ligament rupture is loss of stability increased by quadriceps insufficiency, causing subsequent damage to ligaments capsule, and menisci at each recurring incident. It has already been stated that satisfactory knee joint function within reasonable limits is possible in everyday life in spite of anterior cruciate ligament rupture. This is due to the fact that quadriceps of good volume, tone, and control may compensate to such an extent that few serious symptoms arise from the torn or lax anterior cruciate ligament. This means that the patient can follow his or her normal everyday occupation, even if it be manual, but the knee-joint is not capable of withstanding the sudden stresses and strains that go with body-contact sports such as football. Fairbanks states In civilians, provided their muscles are in good condition, cruciate damage may cause little if any disability and in my experience serious instability is quite exceptional *

It has already been stated that rarely will an operation be carried out to repair the torn ligament in order that the patient can carry out strenuous sport again. Therefore the situation so far as it affects the athlete is that a routine of conservative or non-operative treatment, consisting of re-education and re development of the muscles working on the knee-joint, must be carried out vigorously and conscientiously for a period of

* FAIRBANK, H. A. T (1944), Rehabilitation of the Injured in this War and the Last " *Lancet*, 2, 134.

anything from three to six months There must be a progressive and planned routine of weight bearing exercise for the quadriceps, preferably following DeLorme's system of progressive resistance exercises. In the experience of the author it is necessary for the patient to lift up to 4–5 tons each day on the injured leg This is done of course, in set patterns of progressive weights lifted in repetitions of ten lifts with an adequate rest in between each repetition When the joint is considered ready for sport once again, and this should not be a matter of guesswork or conjecture but should be assessed by means of comparative weight tests following an extensive period of full training, it is advisable for some form of protective and supporting strapping to be worn It is very difficult, if not impossible, for the knee joint to be protected from lateral or rotational strains by adhesive strapping There is one type of strapping however, that has been extensively used by the author and found to be very effective being a source of great physical and mental comfort to the athlete This is known as the Duke Simpson strapping and has been fully described by Augustus Thorndike *

Watson Jones quotes the case of a professional footballer with complete dislocation of the knee and rupture of the cruciate ligaments, who carried out hourly quadriceps exercises whilst the limb was immobilized for three months Despite some laxity the knee is now regarded as normal and stands up to football

Case 8 —Same player as quoted in *Case* 14. As it is considered that this history benefits from being given in its entirety and in chronological order it is given under the heading of the original injury i e Complete Rupture of Fibular Collateral Ligament

Case 9 —An international gymnast, whilst competing in an inter club contest, caught his foot in the mat on landing after a vault over a horse. His knee was subsequently wrenched by the ensuing rotational strain, the foot being fixed and the body falling sideways There was severe pain and loss of function, but as there was no experienced person present immediate measures were not taken. After a very unpleasant and restless night the athlete found in the morning that his knee was grossly swollen and that he was unable to move without severe pain.

* THORNDIKE, AUGUSTUS (1949) *Athletic Injuries—Prevention Diagnosis and Treatment* 206–208 Philadelphia : Lea & Febiger

His doctor applied a pressure bandage and ordered complete bed rest for seven days. During this period the patient carried out no exercises of any sort, and on the conclusion of this period there was considerable quadriceps wasting At this stage the doctor diagnosed a lesion of the medial meniscus but decided to take no further action until the effusion had subsided. When this occurred, and the patient was allowed to become ambulant, he was instructed to carry out quadriceps exercises After a considerable period the quadriceps became fairly good both in tone and volume, and the patient attempted to carry out his normal occupation. He suffered, however from frequent giving way of the knee, and repeated effusions following each incident, and the joint seemed so lax that he appeared to lack confidence in its ability to withstand even everyday use.

At this stage he was sent along to the orthopædic department of the local hospital, where a meniscectomy was advocated. This was duly carried out and routine rehabilitation methods instituted with reasonable initial success. On resuming his normal life, however he again suffered from occasional let downs when the knee gave way and effusions continued. On returning to the hospital, and a further examination of the joint, it was found that he had a ruptured anterior cruciate ligament.

On being informed of the gravity of this lesion, and learning of the prognosis the athlete became depressed, as is to be expected from a sportsman of international standing He was given an extensive and prolonged course of quadriceps rehabilitation, using weights both in a remedial capacity and under an experienced weight lifting coach, who built up his lower limbs by means of progressive exercises using bar bells After seven weeks the athlete was able completely to stabilize the knee-joint in flexion, by means of static quadriceps contractions it being impossible to glide the tibia and fibula forward on the femur

So far so good, but would the knee stand up to the exaggerated strains and stresses of gymnastics? It was not considered possible for the quadriceps however good, to be capable of this task, so supporting measures were taken. These took the form of the application of a Duke Simpson knee strapping as demonstrated by Thorndike, on each occasion when the knee was to be strenuously used. This measure has been completely successful, and the athlete competes regularly and successfully in competitions up to international standard, with no worries or qualms as to the ability of the knee to withstand the demands made upon it.

Case 10 —An amateur footballer of reasonable standard with a history much the same as *Case* 9 Commencing when he twisted his knee during a leap from a wall whilst carrying out a Commando Assault Course, he spent periods in and out of Service hospitals finally receiving a discharge on medical grounds from the Army



Fig 11.—Testing for rupture of the anterior cruciate ligament. There is no excessive forward mobility of the tibia and the ligament is therefore uninjured. (From Sir R. WATSON JONES's *Fractures and Joint Injuries* published by E. & S. Livingstone Ltd.)



Fig 12.—Locked joint. If the longitudinal tear has only extended to a point immediately anterior to the plane of the ligaments the joint will lock in some 40° of flexion; if it has extended far forward into the anterior segment extension may only be limited by 10°. (From I. S. SMILLIE's *Injuries of the Knee Joint* published by E. & S. Livingstone Ltd.)

Played in Senior Amateur football with a very shaky knee having no particularly marked quadriceps development, and with no form of supporting strapping other than an elastic knee-cap On the point of retiring from football when he was given a course of home quadriceps exercises using improvised weight apparatus Each time he played a Duke Simpson strapping was applied and the man was enabled to play another three seasons of good-class football

INJURIES TO THE MENISCI

One school of medical thought asserts that the human menisci lack biological strength, because they act in a joint made susceptible to injury by reason of its late acquisition in Man's evolution. This weakness, if acknowledged, is further apparent in cases where there exists loss of quadriceps tone, volume, and control—three factors predisposing to lesions of the menisci. The footballer is probably the athlete most likely to suffer from this injury, particularly when the tibia is fixed to the ground by the studs of the football boot, and is thus unable to follow violent rotation of the femur

The functions of the menisci are as follows —

1 To increase the stability of the knee joint by deepening the articular surfaces of the tibial plateau

2 To spread a film of lubricating synovial fluid over the articular surfaces.

3 To act as shock absorbers in protecting the opposing articular surfaces.

The lesions likely to be suffered by these structures are very completely given by Smillie* briefly they are —

1 Longitudinal (bucket handle) tears.
2 Transverse tears.
3 Combination of both of the above types of tears.
4 Cystic degeneration.
5 Congenital abnormalities.
6 Tears of regenerated menisci.

Injuries to the menisci take place as a result of abnormal strain placed upon the inferior surface of the menisci and the head of the tibia, due to weight bearing rotational strains of a flexed knee. It is not possible for a lesion of a meniscus to

* SMILLIE, I S (1946) *Injuries of the Knee Joint* 31 Edinburgh E. & S. Livingstone Ltd.

occur as an isolated incident when the knee is in extension in such cases it will be associated with rupture of a collateral ligament at least. Thorndike* claims that meniscus lesions are rarely those of a first strain of the knee-joint, an earlier history of knee strain being present.

The story of the original tear will frequently begin when the knee is severely twisted during a game of football with sudden agonizing pain in the joint causing the player to fall to the ground as the knee gives way under him. When the first wave of pain has subsided, the athlete finds that he can slightly move his knee but that it will not completely straighten (*Fig* 12) Either by a chance movement or by a practised manipulation by a doctor, the meniscus is forced back into place with a click and extension is once again possible.

Subsequently there is a considerable effusion of the knee joint, which will remain painful for some days On apparent recovery the athlete will find that the joint tends to feel unstable on twisting and anything more than a cautious restrained rotational movement will cause the knee to give way and he will fall with it in a semiflexed locked position He may be able to kick it straight this time, or perhaps he will find that it will respond much more easily to manipulative treatment—this will be progressive in that the knee will come out more easily each time, but will click back proportionately easily also After a history of giving way and locking the athlete will be advised by a doctor to have surgical treatment, following which he will have the cartilage removed, spend ten to twelve days in bed, and after five or six weeks rehabilitation will once again be ready to resume training and playing The first injury will, however be the one that actually splits *the cartilage and must necessarily be a weight bearing strain.* Subsequent displacements may occur without weight bearing

The remaining meniscus may be torn in the first few weeks or months of weight bearing following a meniscectomy even though that operation may appear to be remarkably successful This will occur if too strenuous work or exercise is permitted in the presence of an effusion coupled with quadriceps

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THORNDIKE, AUGUSTUS (1949), *Athletic Injuries—Prevention Diagnosis and Treatment* 198 Philadelphia Lea & Febiger

insufficiency The reason for this disaster lies in the fact that the intracapsular structures are softened by the effusion and the joint is inadequately protected because of the lack of quadriceps tone, volume, and strength.

A further point worthy of note is made by Watson-Jones* when he says that the footballer who tears a cartilage in one knee will usually be found to have excessive mobility of the cartilages of the opposite knee which is as yet uninjured. Moreover, he goes on to claim that it is not unusual to find a professional footballer who has ruptured two or even three of his menisci during his career as a footballer, whereas fellow players exposed to similar strains escape without one such rupture this is due to the fact that the degree of mobility of a cartilage accompanying rotation of the tibia varies in normal individuals thus affecting susceptibility to injury

The medial meniscus has a point of attachment to the medial collateral ligament the lateral meniscus has no such attachment, which permits movement of the meniscus as a whole The ligamentous attachment of the medial meniscus is responsible for the injuries to the cartilage in conjunction with strain of the medial collateral ligament, a factor which explains the predominance of medial meniscus lesions over those of the opposite side, a fact generally agreed upon by most medical authorities. Watson Jones mentions that lesions of the lateral meniscus occur six or eight times less than those to the medial Thorndike reports 27 medial to 2 lateral, whilst Smillie s figures show considerable disparity, but follow the general trend, in that there were 727 medial lesions to 406 lateral.

There is considerable difference to be noted when dealing with possible lesions of the lateral menisci as opposed to a tear of the medial. It is rarely possible to fix such a definite history to a lateral tear the original incident often passing unnoticed owing to its triviality and no point of diagnosis is as significant as it is when dealing with a medial lesion The original injury may not even be followed by an effusion whilst, on the other hand the presence of a lateral lesion is sometimes denoted by recurrent effusions having no apparent underlying cause

* Watson Jones, R. (1943) *Fractures and Joint Injuries* vol. 2 712–13 Edinburgh E. & S Livingstone Ltd.

This may be due to the fact that the underlying tear may take a considerable period to reach a point at which it is painfully and prominently demonstrated that something moderately serious is wrong Because the tears tend to be confined to the posterior segment of a lateral meniscus, locking is not as common as in the case of a medial lesion. Generally speaking however a knee that has given way and has no apparent signs of a medial tear should be suspected of having a lateral lesion. This reasoning must also be coupled with tenderness over the joint line and pain on diagnostic manipulation.

Diagnosis of a meniscus lesion is the responsibility of the surgeon or consultant, but before worrying him with a knee showing indefinite symptoms, the physiotherapist frequently desires to have personal conviction that such a lesion exists. It is, therefore, useful to have a knowledge of methods of diagnosis enabling a routine system of examination to be carried out when required. By far the most important single factor in the diagnosis is the history of the case, and this must include the following headings —

a. When it occurred.
b How it occurred—as fully as possible, with demonstration.
c Has it locked in semiflexion ?
d What happened immediately after injury was sustained ?
e Immediate and subsequent treatment.
f Has there been any effusion ?
g Symptoms at time of original injury

Next must follow the physical examination Look for any limitation of flexion or extension, effusion, quadriceps wasting Test for anteroposterior movement, carry out McMurray's and Lambrinudi's tests, search for tenderness over the joint line. The presence of a click or a clunk on carrying out flexion and extension passively with the foot rotated inwards for a lateral lesion and outwards for a medial lesion, is a very definite sign of a tear The line of diagnosis is clearly laid down in Smillie's *Injuries of the Knee Joint*.

Treatment.—

Immediate Treatment —If the dislocated meniscus is not rapidly reduced the patient will find that knee extension is

limited painfully by a spongy, springy factor within the joint there will be considerable effusion, and walking will be extremely difficult. The locked joint must be reduced as soon as possible preferably not later than 24 hours after the original injury after this period the fibrocartilage loses its elasticity and the ability to spring back to its original site because of the soften ing and swelling caused to the meniscus by the effusion The reduction is effected by means of manipulation, which will frequently be found possible without anaesthetic.

The types of manipulations suitable for use by a physiotherapist are clearly described by Smillie* and Cyriax.† That preferred by the former is as follows —

The patient is sitting on a low plinth or chair his foot gripped firmly between the knees of the physiotherapist, who is standing facing the patient. The physiotherapist grips the tibia at its upper third, and at the same time leans back, thus giving a form of traction, whilst rocking the head of the tibia combined with a rotatory movement.

Cyriax has the patient s knee well bent and applies a valgus strain (for medial meniscus) and a varus strain (for lateral meniscus) this opens the side of the joint towards which the loose fragment must be made to move The leg is now rotated to and fro as the knee is gradually extended finally as extension during rotation is being forced, reduction occurs with a click.

Sir Robert Jones s method is to have the patient with a flexed knee and then to give the order One, two three—kick! When the patient extends the limb suddenly the physiotherapist rotates the foot inwards and pulls.

Yet another method is to have the patient lying face down wards with an assistant firmly holding the femur pinned down the physiotherapist stands over the patient, clutching his foot with one hand and his ankle with the other Whilst exerting traction in an upwards direction, the lower leg is rotated slowly until the cartilage returns to its place.

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* SMILLIE, I S (1946) *Injuries of the Knee Joint* 79 and 80 Edinburgh E. & S. Livingstone Ltd.

† CYRIAX, JAMES (1947), *Rheumatism and Soft Tissue Injuries* 286 London Hamish Hamilton Medical Books.

This procedure will apply for almost every initial or subsequent dislocation of a menisci with the exception of a tear confined to the peripheral synovial attachment. This hardly affects the physiotherapist working in sport, if only because the classical treatment includes immobilization for at least three weeks And it must be remembered that recurrent displacement of a torn cartilage cannot be cured by manipulation.

The immediate treatment for any knee that displays insufficient symptoms for a definite diagnosis of a meniscus lesion is very positive. The quadriceps should be worked extremely hard so that they are on a high level so far as tone and volume are concerned, and then the athlete should be sent out to carry on his sport in as arduous a fashion as possible, thus proving the joint sound or causing it to reveal its latent weakness. If it is going to succumb it will do so anyway sooner or later better the former than the latter because of the great advantages derived from an early operation in the prevention of osteo-arthritis and residual weakness.

Conservative treatment should be tried before surgical interference is considered, particularly when it is the first injury to the knee in question. The reasons for this are that a recently injured knee frequently shows many signs usually associated with a torn cartilage the effusion present from the recent injury causes further outpouring of fluid after the operation which delays recovery and thirdly because it will often be found that many of the apparent meniscus lesion symptoms will vanish with adequate treatment and exercise.

Following the manipulative reduction of locking, a firm pressure bandage must be applied, with sponge rubber padding if considered necessary A strict routine of quadriceps exercises must be carried out, and actual weight bearing must be avoided as far as possible When a treat and train policy is desired, the patient must be restricted to body exercises, etc., on a gymnasium mat, many of which also bring in the quadriceps as fixators. It is essential that the joint is brought to a high standard, with little or no effusion remaining and quadriceps at least as good as on the uninjured side. Few surgeons will make any decision unless this is the case a knee presented

to them with a marked effusion and quadriceps insufficiency will only be sent back for the necessary rehabilitation measures before operative decisions can be taken. It is obvious, also that the period of disability following menisectomy is proportionate to the standard of the quadriceps at the time of the operation, a shorter rehabilitation period being necessary if they are of a high standard.

Prior to the actual operation the patient must be fully instructed in the exercises to be carried out during his stay in hospital, he must be told to begin his contractions immediately he comes out of the anæsthetic a well prepared patient will be able to carry out a straight-leg lift within an hour or so of the actual operation. Obviously the hospital concerned will ensure that the athlete is supervised during the immediate post-operative period by a physiotherapist, but he will not be present for twelve hours each day and it is for that period (at regular intervals) that the athlete must work to ensure his quick return to sport.

The actual menisectomy is usually carried out on the third day after admission to the hospital, and the stitches are removed on the tenth or eleventh day the patient usually being discharged on about the twelfth or thirteenth day

LATER TREATMENT —

Home Technique —This will, of necessity be completely pre- and post hospitalization treatment. It will consist of an attempt to build up the quadriceps, by means of home exercise routines, to a high degree of tone and value. Also covered will be attempts to disperse any remaining effusion following the trauma which has necessitated the menisectomy Following the actual operation the rehabilitation will be under the supervision of the hospital physiotherapy department, although the patient will have been fully briefed on the importance of regular quadriceps exercises during his convalescent period.

On leaving hospital provision will undoubtedly be made for attendance at the physiotherapy department and the gymnasium. This routine will be carried out for about three to four weeks, at which the knee will have little, if any effusion, the quadriceps will be reasonably good, although not up to the standard of

the other leg and the patient will then be discharged as being fit for everyday life—as he undoubtedly will be. But he will not be in a fit condition to undertake active sport, although he will probably be able to cope with light training It is therefore essential for a planned and progressive scheme of resistance exercises to be given to the athlete, with firm instructions as to their performance three or four times daily The exercises will be supervised by the physiotherapist twice a week, and if performed actively and conscientiously the athlete should be ready for sport within six to eight weeks of the meniscectomy An adequate functional test must be given before permitting active sport.

Pressure Technique—No better example of this type of treatment of a meniscus lesion can be given than that detailed under in *Case* 11

It has been found useful when an athlete is once again resuming sport following meniscectomy for him to have a supporting strap of adhesive elastic plaster Although the strains to be combated are those of a rotational or a lateral nature, and no known form of strapping can cope with such strains, there is a certain degree of support given, plus a strong psychological reaction, by the following simple strapping Immediately below the bend of the knee, around the heads of the tibia and fibula, apply three or four turns of 3 in. elastic adhesive plaster in a very firm fashion, so that it tightly grips the joint immediately below the joint line.

In the experience of the author the rehabilitation period of a lateral meniscectomy rarely runs as smoothly as that of a medial operation. There seems to be a tendency for effusion to linger for the quadriceps to be more obstinate in regaining full tone and volume, and for the general after-effects to be more prolonged. Can this be due to the fact that those lesions of the lateral cartilage rarely show definite symptoms, thereby causing them to hang about for a longer period before actual surgical interference is contemplated thus causing a greater underlying upheaval within the joint itself?

Case 11—A footballer an international full back, with a history of effusion and general lack of stability within the knee-joint for an eighteen-months period. Twelve months before meniscectomy he

had a manipulation under anaesthesia to relieve a slight lack of complete extension of the knee joint. This was completely successful and he played in a much improved fashion for the rest of the season (4 months) In September he complained of a general tightness around the joint, with recurrent effusion no history of locking or giving way He would receive sufficient physiotherapy to enable him to play a game then he would be under treatment for a further week or so before being able to play again.

In early December the Club Surgeon diagnosed a lateral cartilage lesion, with possible cystic complications. Oddly at this stage the knee was in a much improved condition with little effusion For domestic reasons it was not possible for this player to be operated upon for a further fourteen days this period was therefore devoted to extensive resistance exercise periods to build up the tone and volume of the quadriceps prior to operation. This was carried out to such effect that when he actually entered hospital the quadriceps on the affected leg were in a remarkably good condition.

The operation revealed that the posterior segment of the meniscus had been rolled forward on to the anterior portion possibly during the manipulation carried out earlier Within a few minutes of returning to consciousness the patient was able to carry out a straight leg lift, and began the rehearsed routine of quadriceps exercises Measurement showed that he had apparently lost none of the volume of this group owing to the menisceectomy Under the supervision of both the hospital physiotherapist and the physiotherapist employed by his club he made rapid strides and his sutures were removed on the tenth day and he was discharged from hospital on the eleventh day

Measurement at 5 in. and 9 in. above the superior border of the patella at this stage showed that the affected quadriceps showed no difference in measurement to the other leg There was little effusion and the amount of pain and discomfort suffered at any time during or since the operation was negligible A routine of resistance exercises using a rope and pulley circuit, were immediately instituted and thrice-daily sessions commenced. Using this circuit, six separate groups of ten repetitions each were carried out, with a commencing weight of 10 lb rising to 12½ lb and finally 15 lb—two groups of each weight being carried out. A pressure bandage with sponge rubber padding was worn during all weight bearing periods between exercise.

On the third day or the fourteenth since the operation the player began using weight resistance exercises with a weightlifter's iron boot strapped to the foot—the difference being that, before the initial effort had been greatest decreasing as the exercise continued whilst with the iron boot the effort increases as the exercise progresses He commenced with a weight of 22½ lb doing three repetitions then on to two repetitions with 27½ lb., and a final grand slam effort of

one repetition of 32½ lb These figures were increased over the next fourteen days until he was lifting a total weight of 5 tons per day with a maximum load of 62 lb He commenced light training on the nineteenth day and full training on the twenty fourth day being *completely ready for match play on the twenty-eighth day*

Between the end of December when the meniscectomy was carried out and the end of March he played at least nine games, sometimes twice weekly with little adverse reaction. Very slight effusion occurred after a game, but was countered by the routine application of a pressure bandage and sponge rubber padding Quadriceps exercises using weights were carried out twice daily from the twenty-eighth day and continued throughout the remainder of the season when the player was actively playing

Case 12 —An amateur rugger player with an ill-defined history of effusion and instability of the knee-joint, had a lateral meniscectomy with no previous quadriceps building-up of a specific nature. He suffered considerable pain immediately after the operation, and was not able (in his own opinion) to carry out any form of quadriceps exercises for four days. He was not discharged from hospital until the eighteenth day owing to a persistent effusion. During the hospitalization period he was daily supervised in quadriceps exercises by the hospital physiotherapist, but apparently did little when left on his own.

On discharge, he attended hospital thrice weekly for exercises and commenced his daily work on the twenty fourth day Owing to a marked effusion, a certain degree of limitation of flexion, and a tightness around the head of the tibia, he was unable to play any sport or even carry out any training

After six weeks the knee gave little physical trouble but was swollen and obviously had a considerable amount of fluid present. This necessitated the player wearing a heavy pressure bandage. At eight weeks he began playing, but with little preparatory training and although he was able to get through the game the knee generally did not feel satisfactory The man struggled through the remainder of the season, with ever present effusion, and the complete rest obtained during the close season, coupled with a routine of quadriceps exercises which had been advised by a physiotherapist working with a sports club enabled the man to recommence the following season with the trouble apparently completely cleared up

Case 13 —See relevant section in *Case* 14.

COMPLETE RUPTURE OF THE FIBULAR COLLATERAL LIGAMENT

This ligament is reinforced by the iliotibial band and the biceps tendon, besides being protected from adduction strains by the opposite limb It therefore takes a considerable amount

of violence to cause complete rupture which rarely occurs as an isolated injury but is frequently accompanied by injury to other associated structures.

The following case history appears to be a characteristic instance, and is fully detailed in chronological order

Case 14.—A professional footballer an international centre forward aged 27 years was sandwiched between two defenders during a League match on Dec. 27 1952. The occurrence caused him to fall heavily to the ground in a sideways direction whilst his lower leg was trapped by the legs of his opponents. He suffered immediate excruciating pain and was taken off the field on a stretcher In the dressing room it was not possible to carry out a complete examination owing to the player's pain, because of which he was given morphine the leg splinted, and he was taken to hospital

The orthopædic surgeon who examined the leg reported an extensive injury to the capsule and the lateral ligament, the chief tenderness being rather in front of the ligament itself giving rise to the conclusion that the capsule had been torn as much as the ligament. There was obvious laxity on adduction but a complete tear was possibly doubtful, as there seemed to be a small degree of tightness on abducting the knee, which did not open out markedly on the outer side It was decided to treat the knee conservatively by immobilization and not to operate and examine the ligament. There was also a possibility that the lateral meniscus had been damaged, but this would not be apparent for a while

Plaster-of Paris fixation from toe to groin was applied and the player was told that it would have to stay on for ten weeks With the idea of improving the local circulation, mild short wave diathermy was applied daily through the plaster to the area of the lesion, whilst a planned routine of exercises was carried out. The policy of treat and train was carried out the player reporting to the club each morning and changing into his training kit carrying out light exercises in the gymnasium with the remainder of the players thus obviating any psychological reaction and search for sympathy

The plaster was removed on Feb 3 1953 less than six weeks after its application, and the knee was considered to be in such good shape as to permit it to remain free from further immobilization The quadriceps were considerably wasted and there was a marked degree of effusion to the knee joint. The player was treated as for a chronic effusion, and wore a pressure bandage with sponge rubber padding whenever weight bearing was carried out. At this stage the knee was further examined by the orthopædic surgeon who reported that the knee seemed to be going along very well and that little anxiety remained about the reuniting of the lateral ligament, which

already seemed very stable. There was some suspicion at this stage that there was an associated rupture of the anterior cruciate ligament, as there appeared to be abnormal anteroposterior movement of the tibia and fibula.

Physiotherapy continued being mainly directed towards progressive exercises to build up the muscles of the entire leg, and to maintain mobility of foot, ankle and knee whilst dispersing and checking effusion. As the knee improved, weight resistance exercises were commenced and, as a result of four daily half hour sessions muscle tone and volume were rapidly regained Light training including gentle kicking and running was begun on March 2 and full training on April 7 After two easy practice games within the club he played in the club a third team on April 22 under four months after receiving the original injury He played two more games more than this not being possible as the football season ended he scored a goal in each of the games in which he played two with the injured leg!

Total disability period 3 months, 3 weeks Number of games missed 17 Training missed—no training for 20 days, light training *for 57 days*

During the close season radiographs were taken to demonstrate the degree of laxity films being taken (*a*) as a lateral view with the tibia held forward and then depressed backwards and (*b*) as an anteroposterior view of the tibia held abducted and adducted The normal leg was also taken as a comparison. (*Figs* 13–15)

In mid June whilst playing cricket for a local side, this player swung to one side whilst fielding in the slips and the knee gave way remaining in a locked position. Owing to the absence of the surgeon and physiotherapist who were familiar with the case the knee was allowed to remain in a semi flexed position for fifteen days before the man was admitted to hospital for a meniscectomy Examination showed an obvious medial meniscus lesion and the quadriceps were in an extremely poor condition when the actual operation was carried out early in July

The player suffered considerable post-operative pain and his quadriceps exercise routine was impaired. At the operation it was conclusively proved that the anterior cruciate ligament was completely ruptured no action was taken to repair this structure On being discharged from hospital, after seventeen days, the player began extensive quadriceps exercises using a pulley and weight circuit which was replaced by a weighted boot after a week. The quadriceps regained tone and volume rapidly with progressive resistance exercises, but effusion was difficult to disperse initially Weight-lifting exercises with a bar bell of 90 lb were also used in recognized routines of body building exercises to assist the quadriceps—this was found to be extremely successful and has since been much used in all injuries to the knee-joint (*Fig* 16)

The player began light training five weeks after operation and full training in seven weeks. He played his first game in ten weeks but showed a marked lack of confidence and nursed the injured leg very obviously. It was soon evident that this man would never again be the power in the football world that he had once been, and the situation was further complicated by failure to obtain any covering insurance when he played. This factor was due to the fact that a 20 per cent disability pension had been granted to the player by the Ministry of Health. Subsequently it was decided that he would be better advised to obtain the available financial compensation and to finish playing professional football. Although this course of action has been followed the player now has quadriceps of a higher standard than the uninjured leg and feels fully confident that he could play first-class football as the laxity of the knee-joint has been largely remedied.

Total disability period (second injury) 10 weeks plus 18 days pre-operative. Number of games missed 11 (early season period when two games per week were being played). Training missed—no training 23 days, light training 22 days.

After-note.—In the opinion of the author this player would be fully capable physically of playing first-class football again if aided by the support of a Duke Simpson strapping. Owing to prejudice in professional football circles against such complicated strappings this theory has not been able to be tested.

INJURY TO THE INFRAPATELLAR PAD

The infrapatellar pad of fat lies in the pyramidal area formed above and behind by the femoral condyles, below by the tibia, and in front by the patellar tendon. The pad changes shape with every movement of the joint and is intracapsular, being flattened in an anteroposterior direction when the patella is elevated by contraction of the quadriceps on extension of the knee joint. If the pad is abnormally large, or should the quadriceps lack tone, volume, and co-ordination, it can be nipped between the condyles on extension of the knee-joint causing fibrosis and hypertrophy of the fringes of the pad.

Symptoms of this condition are localized tenderness on palpation and limitation of extension with pain, felt particularly on climbing or ascending stairs. When the condition is acute, retropatellar pain is present and forcible extension will cause local pain as pressure is exerted on the pad. There will be swelling and tenderness when both sides of the tendon are palpated. In the chronic condition localized tenderness is

rarely present, exertion will cause vague retropatellar pain, the knee may be caused to give way by reason of a sudden stab of pain, and mild effusion may exist.

Treatment.—

IMMEDIATE TREATMENT.—As pain only occurs when the knee joint is fully extended, a sponge rubber heel placed in all shoes worn by the athlete, both when walking and playing will often alleviate the condition. Another method is to have the heel of the shoes built up for ½ in. Both these methods have the disadvantage of encouraging quadriceps insufficiency by reason of incomplete extension causing vastus medialis to waste, thus a vicious circle is sometimes set up as this originally may have caused the onset of the condition! Quadriceps exercises must be carried out as a routine measure.

Pressure Technique.—Thrice-daily sessions of short wave diathermy to the pad of fat, followed by quadriceps exercises and a raising of the heel. Deep frictions to the areas of fibrosis on either side of the infrapatellar tendon is also a useful remedy whilst histamine ionization may be substituted for diathermy.

Home Technique.—Contrast baths or hot towels applied thrice daily with a planned routine of quadriceps exercises, with a raising of the heel of the shoes either by means of a sponge-rubber pad or by building up the heel of the shoe. Twice weekly sessions of physiotherapy, consisting of short wave diathermy or histamine ionization plus deep frictions.

Case 15.—County cricketer reported insidious onset of this condition with pain on full knee extension and certain movements when batting. There was slight effusion and swelling, with pain on palpation. The heels of his cricket boots were raised, the heels of his walking shoes similiarly built up and massage given whenever play permitted. After two days the condition was almost cured, and finally dispersed with two sessions of short wave diathermy.

Case 16.—Professional footballer aged 25 complained chiefly of pain in the right knee, with some swelling and loss of flexion, over a two-year period. The player had noticed that slight trauma caused re-activation of the trouble which would appear to have originally started in 1946. During this year he had a medial meniscectomy following a rotational strain with locking of the joint. Six months after the meniscectomy the patient was transferred to his present club and on being medically examined was found to have some swelling

and effusion of the knee with limitation of flexion, and some loss of full extension

The patient was seen by the club orthopaedic surgeon who was of the opinion that the loss of full extension was partially responsible for the lack of stability in the knee he proposed to carry out a manipulation of the joint under anaesthetic. The player was frankly told by the surgeon before manipulation that there was no certainty that full extension would follow but that it was thought to be worth trying The manipulation was duly carried out and followed up by a progressive programme of physiotherapy including non weight bearing quadriceps exercises

The manipulation was not entirely successful there was still some loss of full extension, and the player claimed that it caused further limitation of flexion. The surgeon considered that the only possible failure of past treatment would seem to be the lack of adequate quadriceps exercises after the original operation

The patient attempted to play football managing to play one game, and then missing one or two whilst the resulting effusion was dispersed The close season followed shortly and the patient was kept on quadriceps exercises whilst not playing football but im mediately he recommenced training ten weeks later the knee stiffened and became swollen.

Subsequently the patient was again seen by the surgeon, who following radiography reported that there was now a definite trau matic arthritis affecting the knee with marked X ray changes already (*Fig* 17) The small loose body lying at the back of the knee joint was not considered to be a cause of the symptoms but the limitation of flexion and instability of the knee was due to the arthritis itself In the surgeon s opinion there was no form of physiotherapy or surgical intervention that would ever make the knee one that would stand up to professional football. In that case the days of the player as a professional footballer were ended, as he had only to have a minor injury or twist for the knee to become swollen and painful. Obviously repeated attacks of this nature would do the joint harm The surgeon concluded his report by saying I think that this is a knee that he has got to recognise will never now be 100 per cent It will not give him great disability in a job where prolonged standing or walking over rough ground, etc., is not necessary

A further opinion was sought, on the player's insistence, and the second orthopaedic surgeon stated I agree with the opinion in that further professional football would be damaging to this knee and I am sure that he could not stand the strain of minor trauma or regular match play

Subsequently the player moved from the club and tried to carry on in a lesser grade of football, but without success and he eventually retired from the game

It is possibly also of interest to note that this player had an attack of rheumatic fever whilst in Singapore in 1945 On examination in 1949 his heart showed a regular rhythm and a pulse of 60, the apex to percussion and palpation would seem to be 3½ in. out in the fifth left space. There was no thrill or murmur in any position or after exercise and amyl nitrite. The doctor carrying out the examination reported I wonder if his slow heart rhythm and the stated hypertrophy of the left ventricle is not of the athlete's heart group He was again advised to seek other employment. It is not known whether this particular doctor gave this opinion because of the condition of the knee or because of suspected cardiac complications. Another opinion, however stated that his cardiac state could not be considered abnormal or to present a contra indication to professional football.

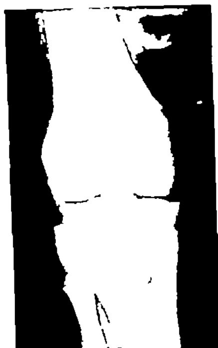


Fig. 13.—Anteroposterior film of the right knee in *Case* 14, with the knee sprung in the direction of the arrow, i.e. medially, thus stretching the lateral ligament, to show the degree of widening of the joint space on the lateral side.



Fig. 14.—Lateral film of the right knee in *Case* 14 with the fibia pulled forward to show the degree of movement in the antero-posterior plane.



Fig. 15.—Lateral film of the right knee in *Case* 14 with the tibia pulled backwards to show the degree of movement in the antero-posterior plane.



Fig. 16.—Athlete carrying out deep knee bends using bar bells, with the object of building up the calf muscles and the quadriceps.

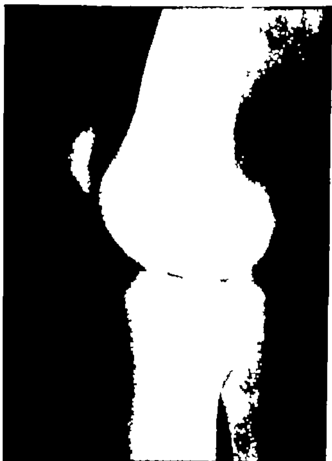


Fig 17 —X-ray film [illegible] *Case* 6, taken 3 years after meniscectomy The surgeon's report states that there are marked changes in the joint caused by definite traumatic arthritis The small loose body lying at the back of the knee joint was not considered to be a cause of any symptoms.

CHAPTER VII

FOOT AND ANKLE INJURIES

As almost every known sport involves the use of the foot and ankle it is obvious that these structures will have a high ranking in any list of sports injuries. It will be seen from the chapter dealing with the incidence of injury that this is the case in those places where statistics and records have been kept. Generally speaking it is very necessary when treating injury to these areas to have a routine system of examination, as the conditions affecting the foot and ankle are many and varied in the world of sport. Accurate diagnosis is essential and within the reach of the average physiotherapist possessing common sense and a systematic mind.

The ankle is a particularly vulnerable part of the body few are the people who have not at some time suffered from a sprain of that joint, whether they be sportsmen or not. It is probably the most common of athletic injuries and possibly the most frequently incurred injury of modern everyday life. The feet are our most important contacts with the earth and suffer frequent minor injuries and irritations. The function of the foot is that of a springy organ of locomotion which prevents jars to the brain, spinal cord, and the abdominal and pelvic organs. The harmful effects of foot disturbances can be reflected in the general health of the athlete, and particularly in the leg knee, hip back, and spine. It is just as easy for an athlete to miss an important match or game through an ingrowing toe nail, or through athlete s foot, as it is through a pulled muscle.

THE SPRAINED ANKLE

A sprain is a stretching or tearing of a few fibres of one or more ligaments forming a joint, the stability of the joint being normal—it is invariably caused by a sudden twisting or

wrenching of the bones forming the joint. Watson Jones* says that in an investigation of 250 ankle sprains it was proven that dislocation of the ankle joint is not an infrequent occurrence. This dislocation is of momentary duration and is spontaneously reduced, but if treated as a simple sprain serious incapacity can remain owing to recurrent dislocation of the ankle joint. This is borne out by the characteristic history of a typical sprained ankle—the initial lightning pain possibly radiating up the leg spasm of the muscles controlling the joint and correction of the abnormal position of the foot and ankle. The patient is frequently able to walk immediately after the injury has taken place, but in a few minutes pain is caused by weight bearing the ankle begins to swell and walking becomes increasingly difficult.

For normal everyday life almost full function will return within three to six weeks, recovery being almost spontaneous. All other things being equal, it will take an athlete, particularly one engaged in a body-contact sport, a further eight to ten weeks to arrive at a stage where match play is safe. Adequate treatment, however will reduce the entire disability period to ten to fourteen days. These remarks apply only to the true sprain and not a complete ligament rupture or a chip fracture. The latter will at least double the disability period, the case being treated without reference to the bony damage, the flake of cortical bone avulsed by the collateral ligament.

The most frequent sprain of the ankle joint is caused by a sudden inversion strain due to an unexpected irregularity in the ground, resulting in damage to the fibular collateral ligament (external lateral ligament) There are three common *sites for a lesion in this structure* in order of frequency they are (1) The posterior part of the anterior portion of the ligament (2) The anterior attachment of the ligament to the talus (3) The fibular attachment of the middle portion of the ligament. Any sprains involving the anterior inferior tibiofibular ligament will give a permanently weakened and widened mortise to the joint.

* Watson-Jones, R. (1943), *Fractures and Joint Injuries* vol. 2, 765 Edinburgh E. & S. Livingstone Ltd.

On examination there will be tenderness on pressure over the injured structure, and swelling and œdema will be localized to the outer side of the joint, in front and below the external malleolus (Figs 18, 19) Inversion of the foot will cause pain, but there will be no lateral instability and no abnormal mobility of the joint. It is easy to diagnose a sprain if it is seen within a short while of its occurrence, it then being possible to locate the site of maximum tenderness accurately over a ligament and not over bone. If a period of days elapses before the injury is seen, the situation will be far more difficult because the joint will have become tender and swollen over a large area localization of the lesion to any one ligament will therefore be difficult.

Treatment.—

IMMEDIATE TREATMENT —A true sprain is a minor injury and quickly responds to treatment if the formation of adhesions is prevented. The ideal treatment of a sprain should commence at the moment of injury, combining the application of immediate local pressure to the injured site with early resumption of activity The application of local pressure within a few minutes of injury is to prevent the formation of a large hæmatoma, the disability period being directly proportionate to the size of the hæmatoma which has to be dispersed. Obviously, therefore the immediate application of means calculated to control the flow of fluid into the joint-space depends upon the trainer or physiotherapist being present when the injury occurs

The boot should not be immediately removed to make an examination, as this permits the swelling to occur unchecked. The athlete is often able to continue playing after methylated spirits, or even whisky, is poured into the boot and a strong supporting strapping applied *outside* the boot. Following the player s return to the dressing room, the ankle should be firmly strapped in eversion, with a 3 in. bandage soaked in spirit or ether meth. He should then be instructed to sit with his lower leg in ice water or if this is unobtainable, in the coldest water possible, for at least half an hour

At the conclusion of this chilling period, the joint should be firmly strapped in eversion, using sponge rubber (cut to shape) to mould around the malleolus, and with a sponge rubber

heel built up on the outside so as to throw the foot over and thus take tension off the injured ligament (*Fig* 20) The aims behind this part of the treatment are to reduce the inevitable effusion to a minimum and also to render movement as comfortable as possible to the patient, thus obviating a limp and the subsequent interference with balance.

The patient is then instructed to use the joint in a weight bearing fashion as little as possible for the next 24 hours he is told to sit with it supported on a cushion and to carry out frequent flexion/extension movements of the ankle.

LATER TREATMENT —With an injury such as this, that possesses strong powers of recovery the role of the physiotherapist is directed towards reducing the disability period to an absolute minimum or even to eliminating any disability and keeping the athlete at almost full activity whilst the injury is healing

Pressure Technique —When the athlete reports with his injury at the conclusion of the 24 hour initial period, the joint will usually be found to be in a swollen condition, with pain on certain movements and definite pain or discomfort on palpation The strapping is removed and the patient is made to sit with his lower leg in a bath of water as hot as can be borne whilst it is in this bath he is instructed to carry out gentle ankle movements. At the side of the bath is a pail of cold water into which the athlete plunges the foot and ankle at intervals, thus creating the contrast bath atmosphere. After half an hour of this treatment he returns to the massage plinth, where massage is given. He then carries out exercises of a mild nature (non weight bearing) and is then once again strapped up with the sponge-rubber padding in position as before.

It has been found useful at this stage to eliminate the use of elastic adhesive plaster owing to the programme of very frequent treatments it is not practicable repeatedly to remove adhesive plaster as this in a very short time produces extensive skin reaction which can cause treatment to be stopped. Instead of adhesive strapping a firm crêpe bandage is used and the sponge rubber is taped into position if it is not possible to hold it in the desired positions until fixed by the crêpe bandage.

In order that the ankle still receives the support necessary, the crêpe bandage selected should not be a new one, but should be one that has been previously used and washed, thus removing some of its elasticity and causing it to be a firmer support.

When the athlete once again stands on his feet after this initial treatment, he will frequently be very delighted by the marked improvement and easing of discomfort—this factor has a very great psychological effect and gives the patient increased confidence in his treatment.

The hot water treatment with massage and exercises, is again carried out in the afternoon and again in the evening, at the conclusion of which the athlete is told once more to rest his leg and carry out ankle exercises at home.

On the following day short-wave diathermy is commenced, followed by massage and exercises—two complete sessions being given during the morning In the afternoon the patient is given treatment by means of a wax bath with massage and exercises, or once again hot water with cold plunge interspersed. In the evening again short-wave diathermy, massage, and exercises. After each treatment the ankle is firmly supported with the bandage and sponge-rubber pads in position It will usually be found possible for the patient to undertake light training of a non weight bearing nature (i.e. body exercises on a gymnasium mat) from the fourth day onwards, whilst light training (less sprinting and kicking a ball) can be commenced on about the sixth day During this training a firm strapping is essential and preferably gym. shoes of a basket ball type, with ankle support, are advised.

To avoid monotony and boredom on the part of the patient, it has been found advisable sometimes to vary the treatment by using histamine ionization instead of short wave diathermy for example A marked feature of the pressure treatment of a sprained ankle is that initial response is remarkably good and for three days the lesion improves astoundingly But for a period lasting about four days following this early reaction there is a static period when the visible improvement is very slight although obviously improvement is taking place. At the conclusion of this static period, on about the seventh day

following injury, the lesion begins once again to improve rapidly and the player is usually able to resume full activity on the tenth to fourteenth day with the aid of firm strapping support, of course

The type of strapping used by the author at this stage is simple in application, consisting of a stirrup of zinc-oxide plaster (or extension plaster) extending under the foot and with tension applied in the direction of eversion. Throughout the application of this strapping the foot is extended over the end of a plinth and is held in a dorsiflexed and inverted position. Next a length of zinc-oxide plaster is applied from the back of the heel in the Achilles tendon area, to extend around to the dorsum of the foot, where it is fixed—it is thus at right angles to the initial stirrup A built up heel of sponge rubber is next incorporated in the strapping and the normal figure-of eight elastic adhesive plaster strapping is applied from within outwards, thus holding the foot in eversion.

Thorndike* says Once a sprain always a sprain and on that assumption advises a strapping support for the remainder of the athlete's active sports career Whether or not this is over-emphasis is debatable, but one thing is certain and that is one must ensure that the athlete does not solely rely on a strapping support to prevent further injuries of a similar nature. It is essential that those muscles working on the ankle-joint, and which pass over that joint, are built up to an advanced condition in order that they can adequately support the joint and thus compensate for the residual weakness left by the lesion. The two best methods of building up these muscle groups are (1) By carrying out heel raising and -lowering followed by repetitions of deep knee-bending whilst carrying a 60-lb or more bar bell on the shoulders. (2) By using a brick, or a piece of wood of a similar size and height, and by standing on it in bare or stockinged feet, carrying out heels raising and lowering, a considerable increase in dorsiflexion being obtained because of the raising of the forefoot on the brick (*Fig* 21)

Home Technique—The patients treated by this form of treatment invariably fall into two distinct categories—the

* THORNDIKE, AUGUSTUS (1949), *Athletic Injuries—Prevention, Diagnosis and Treatment* 72. Philadelphia Lea & Febiger

first type are those athletes who are able to receive immediate treatment along the prescribed lines but are prevented for economic or other reasons from receiving pressure treatment, the second type are the athletes who have received the injury but have had little or no immediate treatment, and, after hoping that the lesion would clear up, have finally decided upon treatment after up to three or four weeks' delay

Those athletes falling into the first category will receive treatment following as closely as possible the lines advocated under the pressure technique heading The frequent short-wave diathermy treatments will be substituted by hot and-cold water treatments at home, taken as frequently as possible The main aim in this type of treatment is to make the patient comfortably ambulant by means of strapping, pads, etc. so that he is able to carry on his normal life in the intervals between treatments. Very firm emphasis must be made upon the importance of home treatment to be carried out by the patient himself and of the vital exercises that he must do When the time comes for the man to resume training or playing it is essential that he is adequately strapped up by the physiotherapist, or, failing this, that he is clearly instructed as to the correct methods of strapping

The second type present obvious difficulties—the physiotherapist is confronted with a chronic condition aggravated by neglect or incorrect treatment. Adhesions have been permitted to form and there is frequently secondary conditions in the form of muscle wasting and muscular imbalance. The ankle is not grossly swollen but is definitely 'puffy' and painful on movement or on palpation. Short-wave diathermy and deep-friction type massage with exercises is the treatment of choice, carried out as often as the patient is able to come for treatment. In the intervals between treatment he must carry out home treatment with hot and cold water plus exercises Above all he must be made comfortable to walk and move in a balanced fashion, thus obviating physical and mental reaction to painful limping The associated conditions must be dealt with often it will be found that his quadriceps have wasted owing to his tip-toe gait which precludes the use of vastus medialis to its fullest extent. The athlete must also be

instructed stringently to ensure that he never carries out any form of active weight bearing sport for a period of several months without a firm strapping support, which he must be shown how to apply Home exercises, using the brick or bar bells, are also essential. It will *often be found that this type* of patient, with a history of neglect, will require manipulation under an anæsthetic in order to break down the restricting adhesions that have formed during the period of non treatment.

Generally speaking there are a number of associated factors in an ankle sprain that require consideration and which should be borne in mind at the time of treatment and rehabilitation. It will frequently be found that the last lingering remnants of pain or discomfort following a lateral ligament sprain are in the region of the tendo Achillis, owing to thickenings which have formed on each side of the tendon caused by bruising drifting from the strained ligament. Another complication which is rather difficult to eradicate is caused by the necessary supporting strapping worn during rehabilitation, which gives rise to tenosynovitis of surrounding tendons. The sites usually affected are behind the malleolus on either side of the tendo Achillis, along the dorsum of the foot and the front of the ankle-joint, and in the peroneal tendons. These secondary conditions must also be cleared up before the anxious athlete is fit enough to resume full-scale activity

It will also sometimes be found that following the restricted movement of a strapped ankle plus an altered gait or postural habit, the small muscles of the foot have been affected. It is therefore a good idea to include a routine of foot exercises in the later stages of the rehabilitation of a sprained ankle.

One marked omission from this chapter on ankle sprains is that concerning the method of treatment by means of anæsthetic injection. As already mentioned in the chapter concerning injuries to the knee joint, in which there was a similar omission this method of treatment has not been included because it does not come under the heading of pure physiotherapy That does not mean however that such a form of treatment is discarded as useless—the author has cause to appreciate greatly the rapid results sometimes obtained by the injection of a few cubic centimetres *of one of* the more



Fig 18.—The swelling and ecchymosis typical of a sprain of the anterior tibiofibular ligament of the right ankle

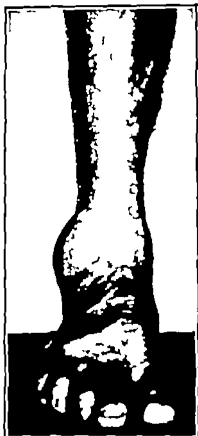


Fig 19.—Lateral view of *Fig* 18 (right ankle) (From AUGUSTUS THORNDIKE's *Athletic Injuries* published by Lea & Febiger)





Fig. 20.—Two stages in the strapping of an ankle in which the external lateral ligament has been damaged. The stirrup is of plaster possessing no lengthways stretch.



Fig. [illegible].—The brick exercise for strengthening the anterior and posterior tibial muscle groups.



Fig. 22.—*Case* 22. X-ray film of the chip fracture showing the detached tip of the medial malleolus.

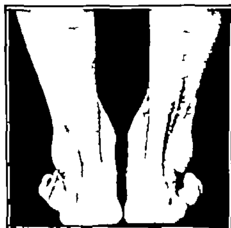


Fig 23.—Swelling present in teno-synovitis of the left Achilles tendon. (From AUGUSTUS THORNDIKE's *Athletic Injuries* published by Lea & Febiger.)

popular anæsthetics such as novocain or procaine The chief value in this form of treatment undoubtedly lies in the fact that it enables the athlete to bear weight immediately and makes possible early movement and function. There is however a marked psychological aversion to its use amongst many athletes, particularly professional footballers, who tend to have been biased by scare stories in the popular press and who seem to think that they are merely being patched up in a temporary fashion so that they can play painlessly although not genuinely fit.

Case 17—Professional footballer sustained a strain of the anterior fasciculus of the lateral ligament of his right ankle when he slipped on a greasy part of a running track during training The ankle was immediately plunged into cold water for a period of half an hour and then was strapped in inversion with elastic adhesive plaster using sponge rubber padding around the malleolus and as a heel support.

From the second to the ninth day following injury he received short wave diathermy massage and exercises twice daily and wax baths massage, and exercises once daily the joint being firmly strapped after each session.

The immediate improvement was so marked that he was given a try-out for a match on the fourth day following injury but although he satisfactorily passed in every phase he had a painful reaction next day which precluded him from actually playing

He played on the tenth day following injury without incident, using a firm strapping support (as indeed he did for the remainder of the season, a period of six weeks) He rested on the day following the game, and as there was a slight effusion on the twelfth day he was given two further sessions of short-wave diathermy massage and exercise.

Total disability period 10 days Light training 6 days missed no sessions of full training Games missed 1

Case 18—Professional footballer sustained a strain of the anterior part of the lateral ligament of the right ankle when his opponent blocked the ball during a tackle causing him to kick an immovable ball with some force.

Owing to the fact that this player was playing away from his home ground the immediate treatments given were of rather a sketchy nature, and almost solely consisted of the application of a crêpe bandage

On arriving for treatment on the second day following injury the ankle was found to be very swollen and in a painful condition, with marked discomfort on inversion, plantar flexion, and palpation. The player was given twice-daily sessions of immersion in hot water

during which time he carried out mobilizing exercises, and one daily treatment of short wave diathermy massage, and light exercise. At the conclusion of each session his ankle was firmly supported with a crêpe bandage and sponge-rubber padding and heel. This system was carried out for three days.

From the fifth to the eighteenth days following the original injury he was given twice-daily sessions of short wave diathermy massage and exercise and a once-daily treatment of wax, massage, and exercises. The ankle was supported during all intervals between these treatments Occasionally the short wave diathermy was replaced by histamine ionization but this was not popular with the player who felt that he suffered a mild headache after each treatment.

On the nineteenth day following injury he successfully passed a try-out and was able to return to the team on the twentieth day He had no adverse reaction and reported no further trouble but was made to wear strapping support for all games and training periods for the remainder of the season (8 weeks)

Total disability period 19 days No training possible 2 days Light training only 8 days Games missed 2

N.B —The original injuries sustained in Cases 17 and 18 were almost identical in nature and severity The marked difference in the disability periods is thought to be entirely due to the rapid inception of the correct immediate treatment in Case 17

Case 19 —County cricketer trod on the ball whilst chasing it during a fielding period, causing him to turn his ankle inwards and to fall heavily

There was a very rapid reaction, effusion and severe pain being present almost from the time of the injury A pressure bandage with lead lotion was applied but no cold application was given.

When he reported for treatment on the day following the injury the entire ankle region was grossly swollen and discoloured. There was considerable pain and walking was extremely difficult. X ray examination revealed no bony injury and strain of the anterior talo-fibular ligament and the anterior part of the lateral ligament was diagnosed.

From the third to the fifth day the patient was given half-hour sessions three times daily of hot water soaking whilst carrying out attempted mobilizing exercises, gentle massage, and supporting bandaging with crêpe bandage and sponge-rubber padding From the fifth to the tenth days short wave diathermy massage, and exercises were given twice daily whilst wax, massage, and exercise or hot water soaking, massage and exercises were given twice daily From the eleventh to twenty ninth days short wave diathermy massage, and exercises once daily histamine ionization, massage, and exercises once, and wax, massage, and exercises once daily—after

each session the ankle was again soundly supported with bandage and sponge rubber padding

He was able to begin practising at the nets on the twenty third day and played in a three-day county match on the thirty fourth day He was told never to take active exercise without adequate strapping support and three months later had reported no trouble

Total disability period 5 weeks No training possible 10 days Light training only 7 days Games missed 5

Case 20 —Professional footballer sustained strain of anterior part of lateral ligament during hard tackle in League match He played on for a further half-an hour and was then able to receive cold water soaking and a pressure bandage At the time of the injury he was treated by means of methylated spirits poured into his boot and a supporting strapping placed over the boot to maintain the foot in inversion.

On the second day following injury he rested the joint, whilst carrying out the prescribed non weight-bearing exercises. From the third to fourth day he was given short wave diathermy massage, and exercises four times daily a supporting bandaging being applied after each session. From the fifth to seventh days he was given histamine ionization, massage, and exercises three times daily As the patient was of an impatient nature, the treatment was varied as much as possible, and on the eighth day he was given wax baths, massage, and exercises once daily and short wave diathermy massage and exercises and anodal galvanism, massage, and exercises once each daily

On the ninth and tenth days short wave diathermy massage, and exercises were given thrice daily The patient successfully passed a try-out on the tenth day and played two games uneventfully using supporting strapping

Total disability period 10 days Light training only 1 day Games missed 1 Treatment sessions given 27

The same player suffered a recurrence of the injury on the third game (16 days later) plus a strain of the anterior talofibular ligament. The aggravated injury was thought to be the result of faulty supporting strapping and unfortunately the immediate treatment given was of an inadequate nature as the man was playing away from home.

Short wave diathermy massage and exercises were given for four days and a supporting strapping was applied. The player returned to the team on the fifth day and has since suffered no trouble

Total disability period 4 days No training missed Games missed 1 Treatment sessions given 12

Case 21 —Speedway rider suffered undiagnosed injury to the ankle-joint during a track incident, but received no immediate treatment. The injury was completely rested for four weeks at the conclusion of this period the anxious patient came along for treatment.

On examination there was considerable effusion and diminishing bruising around the sole of the foot and lower part of the heel. There was pain on palpation around the lateral malleolus and the tendo Achillis, and on inversion and plantar flexion There was also a degree of tenosynovitis to the tendons passing over the front of the joint A certain limitation of movement of the ankle was noticeable, particularly in extension.

The patient was given short wave diathermy massage and exer cise, and a strapping was applied complete with a sponge-rubber heel After the first treatment the patient was able to walk without any limp although this was not possible when he was first seen. The treatment was given four times in the first week. The patient was instructed to give home treatment to himself, consisting of soaking in hot water whilst *carrying out ankle movements.* He was also shown foot, calf and quadriceps exercises as the muscular imbalance caused by four weeks limping had left marked effects on these muscle groups He was also instructed as to the importance of wearing strapping support during all periods of weight-bearing

This routine continued for three weeks at the end of this period his ankle was firmly strapped and he rode in a meeting Although physically almost 100 per cent fit, this rider showed a marked lack of confidence in the ankle for a considerable period and had a strapping support applied each time he rode for over a year

Case 22 —Professional footballer playing in a cup-tie, was tackled very heavily whilst running rapidly and fell with his foot doubled under him obviously in considerable pain. He was quite unable to continue playing and in view of the pain, he was taken to the local hospital There the ankle was X rayed and examined and a diag nosis of fracture of the tip of the medial malleolus was made The ankle was put up in plaster-of Paris fixation and the player allowed to return to his home on the following day

The hospital report read X ray out of plaster shows that the tip of the medial malleolus is detached this also being the point of maximum tenderness (*Fig* 22)

For three weeks the player carried out non weight-bearing exer cises, muscular contractions etc. besides following the club policy of treat-and train in that he carried out body exercises and weight training less weight bearing At the conclusion of this period the plaster was removed and elastic adhesive plaster strapping applied for three days. At the conclusion of this period physiotherapy treat ment was commenced this took the form of exercises to the ankle in hot water followed by thrice-daily sessions of short wave dia-thermy massage, and exercise. After each session the ankle was firmly supported with crêpe bandage strapping

At the end of the fifth week the player was able to begin light training less kicking and his indoor treatment was cut down to

twice daily He passed a fitness test at the end of seven weeks and played without adverse reaction for the remainder of the season.

It is noteworthy that this player faithfully performed exercises for his ankle, using the brick method described elsewhere at home for a period of three months He also was given a daily session of deep knee-bends with a bar bell across his shoulders for two months

Total disability period 7 weeks No training 1 week Light training 5 weeks Full training 1 week. Games missed 9

INJURIES TO THE ACHILLES TENDON REGION

Injuries to this region occur fairly frequently in sport and present a recurring source of trouble if not satisfactorily cleared up initially This is because most sports include movement on the feet, and such action must necessarily involve the Achilles tendon as it is almost impossible to immobilize this structure and still satisfactorily move around enough for successful sport. The only gait which permits movement without pain to the Achilles tendon is one of extreme eversion of the foot, precluding balanced activity

If one is to be guided by the majority of books dealing with trauma and sports injuries, it would appear that the most frequent injury to the Achilles tendon is that of tenosynovitis. The acceptance of this fact would seem to be difficult when it is considered that modern anatomical teaching categorically states that the Achilles tendon has no sheath! That there is a painful and crippling condition involving the tendon cannot be denied, but it is not a true tenosynovitis and is labelled by different authorities as peritendinitis crepitans tenovaginitis or tendonitis Many conditions affecting the Achilles tendon are possibly inflammation of the bursa present between the tendon and the tibia, caused by the spread of the products of bruising from a damaged calf muscle, thus irritating the bursa and making it swell.

Achilles tendonitis as the author knows the condition under discussion, frequently occurs in ice hockey players and cricketers, the former because of the strain placed upon the tendon by the balance and stress of arduous skating under body-contact conditions, and the latter possibly owing to the high degree of foot work involved over a lengthy active period. It would therefore seem to be due in the one case to stress and

On examination there was considerable effusion and diminishing bruising around the sole of the foot and lower part of the heel. There was pain on palpation around the lateral malleolus and the tendo Achillis, and on inversion and plantar flexion. There was also a degree of tenosynovitis to the tendons passing over the front of the joint. A certain limitation of movement of the ankle was noticeable, particularly in extension.

The patient was given short wave diathermy, massage, and exercise, and a strapping was applied complete with a sponge rubber heel. After the first treatment the patient was able to walk without any limp although this was not possible when he was first seen. The treatment was given four times in the first week. The patient was instructed to give home treatment to himself, consisting of soaking in hot water whilst carrying out ankle movements. He was also shown foot, calf, and quadriceps exercises, as the muscular imbalance caused by four weeks limping had left marked effects on these muscle groups. He was also instructed as to the importance of wearing strapping support during all periods of weight bearing.

This routine continued for three weeks; at the end of this period his ankle was firmly strapped and he rode in a meeting. Although physically almost 100 per cent fit, this rider showed a marked lack of confidence in the ankle for a considerable period and had a strapping support applied each time he rode for over a year.

Case 22. Professional footballer, playing in a cup tie, was tackled very heavily while running rapidly, and fell with his foot doubled under him, obviously in considerable pain. He was quite unable to continue playing and, in view of the pain, he was taken to the local hospital. There the ankle was X-rayed and examined and a diagnosis of fracture of the tip of the medial malleolus was made. The ankle was put up in plaster of Paris fixation and the player allowed to return to his home on the following day.

The hospital report read: X-ray out of plaster shows that the tip of the medial malleolus is detached, this also being the point of maximum tenderness. (Fig. 22)

For three weeks the player carried out non weight bearing exercises, muscular contractions etc., besides following the club policy of treat-and-train in that he carried out body exercises and weight training less weight bearing. At the conclusion of this period the plaster was removed and elastic adhesive plaster strapping applied for three days. At the conclusion of this period physiotherapy treatment was commenced; this took the form of exercises to the ankle in hot water followed by thrice daily sessions of short wave diathermy, massage, and exercise. After each session the ankle was firmly supported with crêpe bandage strapping.

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Achilles tendonitis, as the author knows the condition under discussion, frequently occurs in ice hockey players and cricketers, the former because of the strain placed upon the tendon by the balance and stress of arduous skating under body-contact conditions and the latter possibly owing to the high degree of foot work involved over a lengthy active period. It would therefore seem to be due in the one case to stress and

strain of sudden movement, whilst in the other because of prolonged strain over a period. The patient complains of sharp pain on movement and is forced to move in a flat footed fashion, the pain is aggravated if there is a rotational strain with the foot fixed. On palpation there is exquisite tenderness along the length of the tendon, with one key spot that gives more pain than elsewhere. Sometimes a large fusiform swelling can be found an inch from the attachment of the ligament (*Fig* 23)

The condition is usually caused by strain, but can also be non traumatic, an irritative process affecting the tendon itself and causing palpable crepitation. The treatment consists of short-wave diathermy with the condenser electrodes placed one on either side of the tendon, deep friction type massage, and rest from weight bearing whilst carrying out a progressive routine of non weight bearing ankle exercises. At the conclusion of each session the ankle should be strapped with elastic adhesive plaster using a sponge-rubber heel and two strips of sponge rubber on either side of the tendon the foot being in partial plantar flexion when being strapped. When using pressure technique, this treatment can be given thrice daily and will usually clear up the condition within three to five days. Should it not respond to this form of treatment, experience has shown that complete rest from the activity causing the condition must be ordered—it seems to make little or no difference during this period whether treatment is given or not! The condition clears up within about two to three weeks.

Home treatment, unless supplemented by sessions of short wave diathermy, does not seem to be very successful. It would appear that the condition does not react to any form of heat less penetrating than short wave diathermy although bathing with alternate hot and cold water should be tried hopefully The main consideration in both techniques is that the ankle should be adequately padded and strapped at all times when weight bearing If this is done, it will frequently be found possible to keep the athlete at full function whilst treating the condition. The type of high laced boots worn by skaters and cricketers greatly assists in supporting the offending structure.

Case 23.—County cricketer reported insidious onset of pain and tenderness of Achilles tendon at first tolerable but later becoming impossible to run properly or rise up on the toes.

On examination the tendon was swollen slightly and very painful on both sides when palpated the tenderest spot being on the posterior aspect of the tendon about 4 in. from the base of the heel Strapping and sponge-rubber support made a certain amount of difference but the ankle was still not capable of carrying out active work.

Given short wave diathermy massage and exercises in hot water thrice daily with strapping and padding applied between each session. The condition seemed to have cleared up on the third day and the player spent six hours fielding on a bone-hard ground. At the end of the day the tendon was sore but the condition returned as bad as ever on the following morning

Treatment as before for four days coupled with three days complete rest from active work, after which the condition cleared up permanently Ankle strapped for a further month.

Total disability period 8 days Total period of complete rest 3 days Games missed 1 (3-day county match) Number of treatment sessions 20.

Case 24.—County cricketer circumstances almost identical with above case Treatment would secure complete alleviation of symptoms, but a full day's cricket would cause them to return in full strength on the following day

After three periods of treatment and recurrence, the player was completely rested for 14 days without any form of treatment. At the end of the period he seemed to be fit and played for the remainder of the season without recurrence. Always used sponge-rubber heel in his cricket boot after the condition cleared up

Total disability period 26 days Total period of complete rest 14 days Games missed (3-day county matches) 4 Treatment sessions 18

Case 25.—Ice-hockey player found towards end of game that he could not skate properly owing to pain in Achilles tendon area, and had to hold his foot in an everted position to secure any relief.

On examination fusiform swelling half way up length of tendon and marked crepitation, passive flexion, and extension of ankle caused pain.

Six sessions of short wave diathermy massage and exercise, over a two-day period, coupled with adequate strapping and sponge-rubber padding completely cleared the condition. There was no recurrence and strapping with padding was worn for a period of five weeks after injury

Total disability period 2 days Complete rest nil Games missed nil Treatment sessions 6

Two cases have been encountered involving partial or complete rupture of the Achilles tendon in an athlete, and a further case is known in a New Zealand Olympic athlete who suffered almost complete rupture when spiked during a heat of the 800 metres at Wembley in 1948

Case 26.—Professional footballer received injury to Achilles tendon when he fell heavily with his foot trapped between the feet of opposing players. Being of a very tough nature, he continued playing although reduced to about 15 per cent effectiveness.

On examination there was swelling around the tendon and also effusion of the ankle joint itself. Voluntary movement was painful, particularly that of dorsiflexion. Passive movement was not tried at this stage.

The entire ankle joint was given cold applications for half an-hour and then firmly strapped with elastic adhesive plaster and sponge rubber The next three days were spent in attempting to reduce the effusion, and it was soon evident that partial rupture of the Achilles tendon had occurred. It was possible to palpate the gap where the fibres had been torn, and two humps above and below the gap where the torn fibres had rolled back from the site of the lesion.

As already stated, this player was extremely tough, and insisted on being strapped up so that he could play on the following Saturday He also wished to have anaesthetic injected into the site of the lesion, but this was considered inadvisable. The ankle was strapped extremely firmly so that plantar flexion and dorsiflexion were greatly reduced. The player got through the game, playing at centre forward, and scored a goal—but this was due more to his toughness than to the strapping of the lesion.

He eventually (four days later) had to have the lower leg immobilized for three months. He is again playing satisfactorily

Case 27—Professional golfer early middle-age, with well-developed calf muscles, caught his foot in a concealed gutter as he swung his legs out of his car There was acute pain in the lower part of the calf and he was unable to raise his heel, the only gait possible being one with his foot turned out at almost a right angle to the lower leg.

On examination there was a marked gap between the torn ends of the tendon. It was first attempted to immobilize the rupture by strapping the foot in plantar flexion, but after two days it was obviously not successful. Suturing and a plaster cast for three weeks, with the foot in slight equinus, was the next step. This was followed by removal of the sutures and the replastering with the foot at right angles for four weeks. During this period exercises were given to all neighbouring structures not immobilized, and static contractions given to the anterior and posterior tibial groups.

On removal of the plaster the patient carried out normal rehabilitation learning to use on his toes by means of graduated exercises while supported by the back of a chair

Imperfect recovery, including the formation of adhesions, will follow a rupture or tear of the tendo Achillis and be a very disabling factor unless active treatment of the correct type is carried out under supervision of an experienced physiotherapist. Correctly handled, this lesion responds well and the end result is excellent—as in the case of the golfer mentioned above who was taking part in tournament golf within ten weeks of the original injury

TRAUMATIC SYNOVITIS

Non infective traumatic synovitis of the extensors of the ankle is sometimes encountered in athletes It is generally caused by over use of a tendon or group of tendons, or from an unaccustomed strain particularly if prolonged The inflammation generally affects the sheath of the tendon and sometimes granulation tissue forms within the sheath, causing adhesions The smooth lining of the sheath becomes roughened by an exudation of plastic lymph and a serous effusion may follow the resulting fibrosis leads to the painful and limiting adhesions

There is tenderness and swelling of the affected tendon sheath pain except on strong plantar flexion, is not severe, but there seems to be a feeling of weakness when the tendon is brought into use There is a characteristic crepitus a creaking which can be felt and heard when the tendon is moved. In this form there is a deposit of fibrin between the tendon and the walls of the sheath, which creates a characteristic sensation when the opposing surfaces move upon each other If effusion in any quantity takes place the surfaces become separated and the crepitation ceases a fusiform swelling developing along the long axis of the tendon.

In both types adhesions generally form if the part is rested for too long a period, therefore the prevailing dictum of resting the site of the lesion in the acute stage can become rather dangerous when applied to the athlete desiring quick return to his game. Prolonged immobilization in plaster is to be

avoided as much as possible when dealing with the athlete, and few cases seem to be encountered in sport that require this treatment.

Treatment.—

Immediate Treatment.—After immersion in cold water or in ice water for a period of about half-an hour, the ankle joint is firmly supported by adhesive plaster strapping. A rest period of 24–36 hours is advised and the athlete is instructed as to home treatment by means of contrast baths or the application of hot water bottles to the site of the lesion.

Later Treatment.—

Pressure Technique.—Thrice-daily sessions of short wave diathermy or wax baths, with friction type massage and exercises involving flexion and extension of the ankle joint. Passive movements seem to give varied results, some cases appear to prosper whilst others are merely aggravated by them. In the chronic form, when adhesions have formed, treatment is the same as for the acute type, but strenuous forced movements or manipulation must be carried out to restore the free movement of the tendon within its sheath, followed by active movement to prevent the adhesions re-forming. Supporting strapping may be applied if the athlete finds difficulty in moving normally, but owing to the danger of adhesion formation any sort of partial immobilization is to be avoided if possible.

Home Technique.—During the actual sessions carried out by the physiotherapist, treatment should be carried on as mentioned above. It is obviously greatly to the advantage of the athlete if as many treatment sessions as possible are taken, but, if it is only possible to have the occasional session, then a careful routine of home treatment must be prescribed and instructed. The frequent and regular application of heat, by means of contrast baths or by the use of hot water bottles, must be followed by vigorous sessions of exercise.

Case 28.—Professional footballer sustained tenosynovitis of the tendons passing over the front of the ankle-joint by continually kicking a heavy football whilst wearing light rubber shoes. Symptoms were not apparent until later that day when strapping and rest was advised for 24 hours, after which kaolin poultices were used for a further 24 hours, whilst the patient continued resting.

After the 48-hours resting period twice-daily sessions of mild short wave diathermy with deep frictions and exercises were instituted, whilst voluntary exercises in hot water were carried out thrice daily After five days the player was sufficiently recovered to commence training but was not able to kick for a further four days —during this whole period treatment continued as above The player resumed playing 12 days after injury

Total disability period 12 days No training 4 days Light training 13 days Games missed 1 Treatment sessions 26

INJURIES TO THE FEET

The feet suffer constant minor traumata and irritations—unfortunately one pair of feet must last a lifetime. The foot acts as a springy organ of locomotion to prevent jars to the brain, spinal cord, and abdominal and pelvic organs The general health of the athlete is often in direct ratio to the condition of his feet, and it is possible for harmful effects to arise from foot disturbances that will have adverse reactions in the leg knee back, hip, and spine.

A high standard of general foot hygiene and an elementary knowledge of the essentials of chiropody will be of great assistance to the physiotherapist working with athletes There is much in the treatment of simple foot conditions that can come under the heading of plain common sense, and the prevention of blisters, soft and hard corns, hard skin, ingrowing toe nails is not outside the scope of the average physiotherapist. It should be constantly remembered that a player can miss a vital game or meeting through an infected blister or an ingrowing nail just as easily as if he had sustained a strained muscle

A frequently encountered foot condition, particularly in private practice is that of weakness of the intrinsic muscles of the feet. These muscles are, in the main responsible for keeping the bones of the foot in such a position as to maintain the arches and enable trouble free movement of the foot. As a result of continued neglect, the after-effects of an injury or illness, or even because of incorrectly fitting shoes and socks, these muscles lose their strength and tone. This allows the bones to lose their correct positioning and the strain of weight-bearing falls upon the ligaments holding the joints of the foot.

avoided as much as possible when dealing with the athlete, and few cases seem to be encountered in sport that require this treatment.

Treatment.—

IMMEDIATE TREATMENT.—After immersion in cold water or in ice water for a period of about half an hour, the ankle joint is firmly supported by adhesive plaster strapping. A rest period of 24–36 hours is advised and the athlete is instructed as to home treatment by means of contrast baths or the application of hot water bottles to the site of the lesion.

LATER TREATMENT.—

Pressure Technique.—Thrice-daily sessions of short wave diathermy or wax baths, with friction type massage and exercises involving flexion and extension of the ankle-joint. Passive movements seem to give varied results, some cases appear to prosper whilst others are merely aggravated by them. In the chronic form, when adhesions have formed, treatment is the same as for the acute type, but strenuous forced movements or manipulation must be carried out to restore the free movement of the tendon within its sheath, followed by active movement to prevent the adhesions re-forming. Supporting strapping may be applied if the athlete finds difficulty in moving normally, but owing to the danger of adhesion formation any sort of partial immobilization is to be avoided if possible.

Home Technique.—During the actual sessions carried out by the physiotherapist, treatment should be carried on as mentioned above. It is obviously greatly to the advantage of the athlete if as many treatment sessions as possible are taken, but, if it is only possible to have the occasional session then a careful routine of home treatment must be prescribed and instructed. The frequent and regular application of heat, by means of contrast baths or by the use of hot water bottles, must be followed by vigorous sessions of exercise.

Case 28.—Professional footballer sustained tenosynovitis of the tendons passing over the front of the ankle-joint by continually kicking a heavy football whilst wearing light rubber shoes. Symptoms were not apparent until later that day when strapping and rest was advised for 24 hours, after which kaolin poultices were used for a further 24 hours, whilst the patient continued resting.

INJURY TO THE PLANTAR FASCIA

The plantar fascia extends from the calcaneous to the four outer toes and is a sheet of pure fibrous tissue, damage to which causes extreme pain, limitation of movement, and sometimes deformity The leaping and jumping involved in many forms of sport cause jarring leading to sprain or strain of this structure, it is also under considerable tension in cases of flat foot. Some authorities consider that it is the inferior surface of a calcaneal spur that becomes inflamed and tender, but it is generally considered to be the fibres of origin of the fascia that are hurt.

The athlete will complain of a dull, bruised feeling which is emphasized by palpation or weight-bearing On palpation there will be found to be tenderness more on the medial side, along the attachment of the fibres of origin The condition is also caused by overstrain, under such circumstances as a cross-country or marathon runner would encounter, when his over-tired feet continue to receive punishing pounding when they are beyond the state of fighting off injury

Treatment.—

Immediate Treatment —This is not always easy to attempt, as the condition is frequently insidious in its onset, and has merged into the subacute state before being presented for any form of treatment. However under circumstances as mentioned above involving marathon runners for example, the feet should be washed and dried thoroughly, and then powdered with a good foot powder A cheap and effective foot powder can be made up as follows —

Salicylic acid	3 parts
Boric acid powder	10 parts
Powdered talc	87 parts

At all stages of treatment the strain must be taken off the plantar fascia by the maintenance of plantar flexion at the mid-tarsal joint during weight bearing As a long term policy the heel of the shoe must be built up while keeping its upper surface horizontal. But as an immediate measure a rubber heel pad or a ¼-in. wheel of cork, cardboard etc. inserted inside the shoe will make the necessary difference.

Such a role is not suitable for these ligaments therefore when it occurs it causes considerable pain and discomfort. Obviously there is but one solution, the muscles must be built up to their former state of strength by means of a routine of progressive foot exercises—such a system is the same whether carried out under constant supervision or at home, when the patient must have been amply instructed and informed as to the importance of the task in hand. Strength cannot be gained in the muscles of the foot until adequate mobility has been obtained, manipulation must therefore be carried out and the patient instructed in passive movements with the same objective. The severe condition will probably benefit initially from faradic footbaths

Case 29.—A Canadian ice-hockey player weighing 15 st. found over a period of weeks that after a few minutes playing his foot became intensely painful within his boots and skates. There was a sharp burning pain running along the sole of the foot and, after attempting to carry on normally for about ten minutes a cramp-like pain made skating almost impossible.

On examination the foot appeared to look quite normal when at rest, but on standing there was a definite sagging of the arch on the medial side of the foot. The forepart of the foot seemed to be splayed and a general tenderness was evident on palpation. It was difficult for the patient to rise on to his toes when standing, and he said that this inability was due to a combination of pain and weakness.

As a safety precaution the foot was X rayed to exclude a march fracture, and on a negative report being received treatment for general weakness of the intrinsics was commenced. Thrice-daily sessions of faradic footbaths were given for half an-hour at a time, accompanied by a routine of foot and ankle exercises Massage to the foot and lower leg was given once daily and a metatarsal pad of adhesive felt, plus a sponge-rubber heel was ordered to be worn constantly The patient was excused all training and ordered to limit weight bearing to a minimum for 72 hours. At the end of this period there was a marked improvement, and the faradism was stopped—extra active exercises being substituted.

The player appeared to be completely cured at the conclusion of seven days treatment, and played hockey on the eighth day with no adverse effects. He has since suffered no recurrence, but has intermittently carried out exercise routines to strengthen the muscles of the feet.

Total disability period 8 days No training 3 days Light training 2 days Games missed 1 Treatment sessions 21

the feet. When this last condition occurs, the flexor muscles of the toes become weak so that insufficient weight is borne by the pads of the toes in walking, this means that excessive pressure is placed upon the metatarsal heads The pain is situated beneath the heads of the metatarsals and is continuous and burning

Actually this condition is capsulitis, because it is the plantar aspect of the capsules of the metatarsophalangeal joints that are tender On examination there may be oedema of the dorsum of the foot and actual wasting of the small muscles of the foot. This latter, coupled with the exquisite tenderness that is so typical of this condition, inevitably leads to alterations in postural habits and muscular imbalance, both vital factors to the athlete.

The causes of the condition are easily understood, being secondary to another condition or else being an acute traumatic symptom. In the first case the causes are largely postural in origin, and are associated with the same factors that cause painful flat-foot. Any injury to the foot that tends to give rise to a pes plantaris deformity or a pes cavus deformity will produce metatarsalgia. The traumatic cause usually occurs when the athlete treads heavily onto a stone or a piece of wood when running or jumping, many professional footballers acquire this condition through training for a lengthy period on a surface rich with small pebbles when wearing soft rubber shoes.

There is another type of metatarsalgia that has been encountered in the world of sport by the author which seems to fulfil the description of Morton's metatarsalgia. This is said to be a compression metatarsalgia in which the heads of the metatarsals are bunched together so that the digital nerves which pass between them become compressed giving rise to a digital neuritis Other sources state that the symptoms may result from nipping of a neuroma in the fourth metatarsal interspace or an overstretched fourth interosseous muscle However it is not thought that the condition affecting athletes is of such a severe nature as these descriptions The symptoms consist of a sudden pain on the outside of the foot, and are usually found to be caused by the wearing of a running shoe

LATER TREATMENT —

Pressure Technique —This is a most obstinate, and often prolonged, condition and frequently takes a considerable amount of treatment before being satisfactorily cleared up The most effective, and indeed the only apparently satisfactory, form of treatment is short wave diathermy, deep friction type massage, and non-weight bearing foot exercises, plus faradic footbaths if required. The patient has to be instructed that he must wear the pads supplied and restrict his weight bearing as much as possible until the condition markedly clears up The treatment sessions can be given thrice daily, but if the patient has to bear weight for considerable distances each time he arrives for treatment, it is better to cut down the number of sessions and set out an adequate scheme of home exercises, etc.

Home Technique —As short wave diathermy appears to be the only form of electrotherapy that will help this condition, the treatment sessions should consist of the same routine as given above. If this is not possible, then the patient should be given full routines of home exercises, instructed in limitation of weight bearing and given padding to maintain plantar flexion at the midtarsal joint. Wax baths or hot water bathing are sometimes effective but not very often.

If all these methods fail, the only effective form of treatment is complete rest from weight bearing, whilst carrying out foot and ankle exercises.

METATARSALGIA

When an excessive proportion of the body weight falls upon the forefoot, normally constructed to bear only about one-third of the body weight, it causes pain at the plantar aspect of the forefoot. This pain which is felt in the region of the outer metatarsophalangeal joints, is known as metatarsalgia. When too much pressure is borne by the forefoot or when the toes are taking none of the body weight, the plantar aspect of the capsules of the middle three metatarsophalangeal joints develops a traumatic tenderness.

The condition may be caused by trauma, toxic influences, or any factor which results in the loss of tone of the muscles of



Fig. 24.—Metatarsal pad of adhesive felt.

or football boot that is too tight or too narrow Yet another cause occurs when the professional footballer, who routinely straps his ankles in a figure-of-eight fashion for each match, does so in too tight fashion. The sole and most effective treatment, merely consists of advising the athlete to wear shoes that are wider or to avoid strapping his ankles too tightly

Treatment.—

IMMEDIATE TREATMENT —Early treatment of the more common type of metatarsalgia consists of measures designed to take the pressure of weight bearing off the metatarsal heads. This is done by using suitably shaped pads of sponge rubber on the plantar aspect of the foot.

LATER TREATMENT —

Pressure Technique —In the acute stage the main aim of treatment is to alleviate the exquisite tenderness this is done by means of short wave diathermy or histamine ionizations followed by friction type massage. The exercise sessions should consist of routines designed to strengthen the short flexor muscles of the toes, thus enabling them to be strongly flexed during weight bearing The general effect of this is for the flexion to make the toes bear weight, thus taking some of the pressure off the metatarsophalangeal joints. At this stage it will often be found that faradism is of great use applied by means of footbaths Thus the programme should be worked out so that each day sees three sessions of soothing short wave diathermy with massage whilst exercises of a voluntary nature coupled, if required, with faradism occupy the latter part of each session

At the conclusion of each treatment session the tender plantar areas must be protected by sponge rubber pads (*Fig* 24) and it will sometimes be found that a straightforward strapping around the dorsum and plantar aspects of the foot with elastic adhesive plaster helps the athlete to again walk normally Massage in the subacute or chronic stage may be given by means of an electric vibrator the use of which seems to be particularly effective when treating metatarsalgia.

Home Technique —The treatment sessions must be thorough and consist of much the same as given above. The same emphasis on sponge rubber padding to remove pressure must

be applied and adequate demonstrations of foot exercises given so that they may be carried out under home conditions Contrast bathing twice daily is of use and will to a small extent, take the place of the frequent short wave diathermy sessions given under pressure technique conditions

Case 30 —Professional footballer sustained acutely painful condition of plantar aspect of right foot with palpable tenderness of capsules of the third and fourth metatarsophalangeal joints The condition was caused by the sudden transition of underfoot conditions, when the player changed his training from a soft turf field to a gravel car park, during which training he wore soft rubber shoes One day's training session was sufficient to give rise to an acutely painful condition which made walking difficult.

For the first twenty four hours padding with sponge rubber and a light adhesive strapping were applied, whilst the patient was told to refrain from weight-bearing and to carry out general foot exercises.

Following this period, short wave diathermy friction type massage, and faradism were given thrice daily padding being applied after each session. On the third day faradism was stopped and the vibrator was used for the massage Symptoms were almost non-existent from the sixth day onwards but sponge-rubber padding was worn for a period of fourteen days—and training on the gravel surface was ended permanently!

Total disability period 6 days No training missed completely Light training 3 days Games missed nil Treatment sessions 16

Case 31 —A rugger player acquired metatarsalgia following a chip fracture of the anterior fasciculus of the lateral ligament of the right ankle. Owing to his inability to maintain regular treatment of the original injury coupled with an inherent reluctance to carry out foot exercises whilst endeavouring to continue at his normal occupation, which involved a considerable amount of standing he lost a large degree of tone of the small muscles of the foot.

Sponge rubber padding plus faradic footbaths and a rigorous routine of supervised foot exercises, dispersed the condition in eight days.

Case 32.—A footballer complained of sharp and sudden pain on the outer border of his foot, with pain on weight bearing following a heavy programme of matches over a holiday period. It was thought at first that he had sustained a contusion on the dorsum of the foot, but there were no signs or history of this occurrence On examination there were no visible signs of injury but a palpable area of pain over the lateral border of the foot and extending under the plantar aspect to the heads of the two outer metatarsals

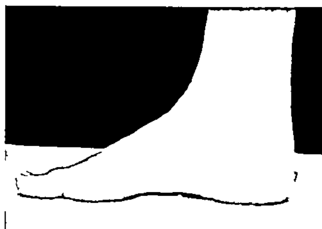


Fig 25 —*Case* 33 Photograph of foot (owing to soft undersurface on which the patient is standing the high medial arch is not shown to best advantage)



Fig 26 —*Photograph of a case of hallux rigidus* Note prominence on the head of the first metatarsal bone formed by the exostosis and the long narrow foot This case responded well to treatment by manipulation under an anæsthetic, followed by exercises under supervision. (From PRATT's *Essentials of Chiropody* published by H. K. Lewis & Co Ltd.)

short flexor muscles of the sole of the foot. This improvement is designed to make them adequate to take more of their responsibility of stress and strain thus relieving tension on the capsule of the joint. Later a short session of passive foot manipulative movements was given after each exercise session to ensure that full range of midtarsal movement was maintained.

From a prophylactic view it is difficult to know quite how to prevent this occurring in a player possessing such apparently ideal anatomical breeding grounds for the condition. Mr Grant Bonnin in his book *Injuries to the Ankle Joint*, mentions a steel support fitted within the football boot, to extend from the heel to the metatarsal heads and moulded to the sole of the foot. Such an apparatus would be extremely unpopular with the professional footballer, partly because of the increased weight factor and partly because of its comparative impracticability in the lightweight football boots in use to-day. In the case of this particular player strict supervision is exercised in the matter of maintaining the tone of the muscles of the foot, plus an adequate and firm strapping support of the ankle and midtarsal joint region for each game. By these means, a recurrence has now been avoided, at the time of writing, for over two years.

Total disability period 9 days Light training 6 days Games missed 1 Treatment sessions 18.

Since then the player sustained a heavy kick on the dorsum of the foot, requiring an X ray to discount any possible fracture. The radiologist's report read as follows "The film shows a small bony fragment lying on the dorsal aspect of the joint between the scaphoid and first cuneiform. It appears to me that this fragment has been a spur on the posterosuperior aspect of the first cuneiform and has been detached, possibly owing to injury some months ago but probably at a more distant date. There is also a spur on the anterior articular margin of the lower end of the tibia, but this is unlikely to be causing symptoms."

HALLUX RIGIDUS

This condition might almost be called the occupational disease of professional footballers, although cricketers suffer from it frequently. Caused by constant injury to the metatarso-phalangeal joint of the great toe by continual stubbing against the hardened toe of the boot, this is a condition in which there is limitation of the normal range of movement of the great

On investigation it was discovered that the player had worn, for the first time over the holiday a pair of lightweight leather and rubber boots suitable for hard dry grounds. They were of a considerably more narrow cut than his normal boots and on resuming his usual footwear the condition immediately vanished.

No disability period or treatment given.

MIDTARSAL STRAIN

This condition is not frequently encountered in sport in fact only once has it crossed the author's path. However, it had various outstanding points of interest that make it worthy of consideration here When one contemplates the midtarsal joint it is understood that it is the calcaneocuboid and talonavicular joints that are under review

Case 33—The patient in question had an abnormally overarched foot, with a degree of hypermobility of the ankle joint (*Fig* 25) Over a period of years the man (an international professional football player) had recurring attacks of the condition and it seemed usually to occur at about the mid-stage of the season. He complained of pain when the foot was passively rotated abducted, and dorsiflexed, with a degree of instability of the foot generally so that he complained of having a fear of it "letting him down Most movements involved in strenuous weight bearing such as during a football match, were painful and became increasingly so as he continued to play

After a considerable amount of investigation it seemed that the player had a certain lack of muscle tone in the small muscles of the foot, which made them inadequate to maintain a normal degree of plantaris position of the forefoot during weight-bearing This caused the capsule of the midtarsal joint to become strained or stretched, the calcaneonavicular ligament and the plantar fascia also being stretched, because the foot was dorsiflexed and abducted at the midtarsal joint by weight-bearing (*Fig* 25)

The player was advised to restrict weight bearing to a minimum for about 5 to 7 days, an inner heel of sponge rubber was fitted to his shoe and a strapping applied as a routine measure between treatment sessions. This strapping was made from extension (one way stretch) adhesive plaster applied with the foot held at right angles and in a varus position, applied in the form of three overlapping stirrups, being initially fixed to the lateral aspect of the lower leg and finally fixed, under tension, to the medial aspect of the lower leg It was carried around the midtarsal area below and served to steady the calcaneo-midtarsal region.

He was given thrice-daily sessions of short wave diathermy and massage, followed by faradic footbaths and exercises to improve the

localized massage followed by a period of active exercise with the foot in hot water or hot sand. Wax baths also have their place in treatment. Following the hot water, etc., the toe should be given gentle traction manipulations, and then supported as explained above At the conclusion of the day's treatment, a collodion and gauze splint is affixed so that it partially immobilizes the metatarsophalangeal joint. This routine should be followed four times daily

As it is usually found that the cases of hallux rigidus that arrive to be treated are chronic conditions that have flared up owing to mild trauma, the routine of treatment does not last for long but usually continues for about four days At the end of this period the player is sufficiently relieved to resume training or playing if he has had to stop at all In the experience of the author, the same players will report perhaps thrice during a season with this condition and will receive their routine treatment for a short period, after which they will not be seen again until the next occasion on which the pain is encountered. It is found to be useful if the joint is supported by a bar of adhesive felt during a game or during strenuous training sessions.

Home Technique—Short-wave diathermy as often as possible with massage and supporting strapping Home exercises to be carried out in hot water and the joint to be wrapped in an electric blanket or hot water bottle during the night hours Kaolin poultices are of use, but difficult to apply and retain on the foot unless the patient refrains from all weight bearing

If it is possible to persuade the athlete to have some mild form of rocker sole fixed up it helps but it has the obvious disadvantage of encouraging muscular imbalance in the highly-trained and balanced athlete

toe. The continual recurrence of the injury ultimately causes degenerative changes to take place, leading to osteo-arthritis, and any local condition which will destroy the joint surfaces will ultimately lead to ankylosis.

On examination, the big toe is often broadened and the pulp flattened out, the distal phalanx being held in hyper extension (*Fig* 26) There is limitation of movement in all directions, indeed sometimes no movement at all is possible. Pain is most marked when walking or running and the trouble never spreads to other joints.

The generally accepted forms of treatment are not easy to carry out when dealing with athletics, consisting as they do of the provision of a rocker sole to the patient's shoe, so that he pivots instead of extending his big toe. The other accepted alternative seems to be a metatarsal bar put straight across the sole at the metatarsal heads.

Obviously the condition is best treated by means of prevention, by ensuring that the athlete does not wear football boots with an unblocked toe, or that they are too large for him so that his toe has room to move forward and jar on the toe-cap The initial incident must be a warning, and stringent measures taken to ensure that it is cleared up quickly and prevented from recurring Operative measures merely to ensure that a man can again play football do not seem to be popular with *consultants, but could possibly be carried out successfully* once

Treatment.—

IMMEDIATE TREATMENT —The foot should be placed in ice water for a period of 30 minutes. The next step has been found empirically to be sound and consists of the application *of a pad soaked in Liniment A.B C (Aconite, Belladonna,* and Chloroform) and held in position by an elastic adhesive dressing around the joint. Under the toe a strip of stiffened adhesive felt is placed to prevent painful movement. The patient is instructed to carry out hot and cold water bathing four times daily for the next 24 hours

LATER TREATMENT —

Pressure Technique —On conclusion of 24 hours resting period, the treatment of choice is short wave diathermy with

when the part on which they act is fixed or steadied by the damaged group In can generally be assumed that athletic efficiency will be impaired in two ways —

1 Chiefly as the result of loss of tone, the original muscle strain will partially or wholly put the muscle out of action

2 Other muscles will become affected by the excessive effort thrown upon them when they have to work at a disadvantage owing to lack of assistance from the damaged group

In the case of a slight strain there is no actual macroscopical damage detectable although microscopical lesions may exist. The forced extension of the muscle causes impairment of its contractibility and tonicity whilst its irritability may be increased or diminished The immediate result is that the muscle becomes relatively lengthened and therefore not capable of its full normal contraction, its working capacity is thus placed at a mechanical disadvantage The delicate connective-tissue of the muscle may be injured, the resulting hæmorrhage and œdema producing undue tension in the muscle tissue, the stretching of the parts causing pain

When a severe strain occurs actual rupture of multiple or individual fibres may occur The supporting connective-tissue framework will be damaged and the muscle sheath and its attachments may be ruptured. In addition to the visible damage to the site of the lesion, contractibility and tonicity will be greatly impaired and irritability heightened.

The signs and symptoms of a strained muscle are those of acute pain the athlete will sometimes assert that he has been shot or struck sharply with a stick at the site of injury, and there will be immediate complete loss of function of the muscle involved. There is local tenderness and swelling and it is possible to localize the site of the lesion by means of resisted voluntary movement of the muscle groups in the area affected.

It is essential that the tendons should be equally capable of efficient repair when injured, as their task is to transmit power from the muscle belly to the bone, acting as a flexible piston rod They are usually strained at a tenoperiosteal junction, although lesions can occur in their substance. A slight rupture occurs in most cases

CHAPTER VIII

MUSCULAR STRAINS

When the tissues of a muscle have been damaged as a result of the contraction of that muscle not having been powerful enough to resist the stretching effect of an outside force at the moment of its application, a state known as 'strain' can be said to exist. The physiological properties of muscular tissue can be said to be (*a*) Elasticity, (*b*) Contractibility (*c*) Irritability (*c*) Tonicity The normal healthy muscle cannot overcontract, because the power it possesses to contract is limited to a certain maximum. The tonicity of a muscle causes it to be always in a state of readiness to respond to any sudden stimulus the elastic property of the connective tissue forming the muscle from its origin to its insertion greatly *assists in this process.*

In sport great stress is placed upon muscle tissue with no resulting harm, unless that applied force overcomes the power of the muscle when it is contracted to the full extent of which it is capable or if its fibres have not reached their fullest contraction. This bears out the already-mentioned point concerning the possibilities of a muscle overcontracting, by emphasizing that damage is not done by the muscle overcontracting to resist the applied force. When the degree of violence or stress overcomes the muscle's power of contraction, varying degrees of damage are sustained, sometimes to the muscle tissue alone or it may extend to one or more of the component parts of a joint. Muscular tissue may be injured in an attempt to prevent damage to other structures of a joint on which they act, thus causing that joint to have impaired efficiency owing to the deficient action of the damaged muscles during their repair period. On the other hand, strain to one group of muscles may cause indirect interference with the action of a group of undamaged muscles, which work to best advantage

bridging the separated ends Owing to the inability of this new tissue to relax and contract like muscle tissue, a certain amount of disability will result. This does not prevent the functional result from being good and capable of eventual improvement when the scar tissue shortens and brings the torn ends of the muscle closer together There is a school of thought that postulates the theory that such scar-tissue formation as occurs when a muscle is torn can be gradually softened and eventually partially replaced by healthy muscle tissue if the lesion is treated throughout the disability period by means of deep friction type massage and graduated exercises

The repair of tendinous lesions is extremely good when it is considered that tendons are practically non vascular tissue thus being incapable of supporting the circulatory phenomena seen in the repair of vascular tissue. Blood from the parts adjacent to the injured tendon fills up the gaps in the tendon caused by the injury The resulting blood-clot forms a sort of temporary scaffolding being replaced later by cells formed as a result of the division of the cells forming the lining of the inner layer of the connective-tissue sheath of the tendon, and by actual proliferation of the tendon cells themselves. It is thought that the repair tissue is more likely to consist of connective tissue if the gap is large this is later replaced by the further development of tendon cells. It is a known fact that, after a lapse of time, the power to withstand the heavy stresses and strains of sport increases in a repaired tendon, when its resiliency is restored During the processes of repair adhesions may form and bind the inner surface of the tendon-sheath to the enclosed tendon thus limits the free movement of the tendon within its sheath. This can be prevented by not allowing the two sticky surfaces to be too long in contact, graduated movements and deep friction massage, causing the inner aspect of the sheath to be moved repeatedly backwards and forwards across the surface of the tendon, will prevent this tenovaginitis

The coagulable lymph that is poured out to effect repair of the subcutaneous wound that results when muscles are severely strained can cause adhesions to form that will restrict movement. In order to obtain relief from pain following injury

Strains of muscular tissue can be prevented to a certain extent, or at least guarded against, by the regular performance of strengthening exercises designed to build up the muscle groups most affected. These muscles are most commonly the plantaris hamstrings, quadriceps, biceps, humerus, *supraspinatus iliopsoas and Achilles tendon, with occasional* trouble to the posterior tibial group Resisted exercises, using either weights or manual resistance carried out regularly will go a long way towards cutting down the incidence of muscular strains Another preventative factor is that of ensuring that no septic foci exists in the body of the athlete regularly organized checks can eliminate infected tonsils, adenoids or carious teeth. Recurrent strains, or old injuries incorrectly treated originally should be supported by means of adhesive strappings, but strengthening exercises should be supervised so that the artificial aid given by the strapping can eventually be eliminated. *Another potent factor in muscular* strain prevention has been found to consist of a daily routine of exercise in which the principal muscle groups are put through movements designed to overstretch them gently thus rendering them capable of that vital degree of hyperelasticity that may prevent a pull

The aims of treatment when dealing with a muscular strain are (*a*) To restore muscular tone and strength as quickly as possible (*b*) To form a strong and mobile scar and (*c*) To enable the athlete to move and train in such a way as to be bilaterally balanced, thus avoiding increased disability periods by reason of muscular imbalance and incorrect postural habits.

When a wound takes place along the length of a muscle the incompletely damaged fibres will show great powers of re formation and the sides of the wound will keep in a fairly good state of apposition. Thus the neighbouring muscle cells are able to proliferate and a good repair results without the formation of very much scar tissue. A lesion across the long axis of the muscle causes the severed ends to separate as the fibres contract, thus a gap in the tissue is formed. In such cases repair is less efficient because more scar tissue forms than does muscle tissue. The gap is closed by a blood-clot, which acts as a scaffolding until it is replaced by scar tissue thus

aids in the dispersal of the effusion During this period, if the patient must be at all ambulant, he will be helped by the provision of sponge rubber padding and a sponge rubber heel in his shoe. It has also been found useful to instruct the patient not to wear low heeled slippers during this period or during the early stages of the injury, as this lowering of the heel places undue strain and sometimes stretches on the muscle groups affected with resulting pain and delay in recovery

It is essential during this acute period that no form of heat or massage is given to the site of the lesion. Torn muscle tissue bleeds and the physiological effects of heat and massage are to improve local circulation, amongst other things, therefore they will cause the hæmorrhage to be aggravated. As the principal aim of treatment is to minimize the size of the hæmatoma resulting from the strain, any factor that causes additional bleeding is directly contrary to a speedy and satisfactory result.

At this stage the question of the injection of anæsthetic must arise. It has already been stated that this method of treatment lies outside the scope of the physiotherapist, but it is nevertheless much used and is a potent factor in the cure of many sports injuries, and for that reason must be considered by the physiotherapist, who in the light of the experience gained by others might have on occasions to suggest this form of treatment to the doctor with whom he is working Many very eminent authorities consider that the full mobilization of an acute muscle injury by the immediate induction of local anæsthetic enables the lesion to be treated vigorously with considerable benefit during its most acute stage. Cyriax states that the sooner local anæsthetic is injected the better as the free active movement secured by this method is better suited to the maintenance than the restoration of muscular mobility * He also gives as an opinion that the use of anæsthetic injections is best confined to a primary injection, followed by deep massage, as a second injection is rarely as effective as the massage. Obviously active movements are the main

* Cyriax, James (1947) *Rheumatism and Soft Tissue Injuries*, 21 London Hamish Hamilton Medical Books.

the part is placed in a position that tends to reduce the internal pressure due to effusion by complete relaxation of the muscles —the position of greatest ease. If absorption does not take place or is delayed, the lymph becomes organized and forms adhesions, which are highly sensitive and will directly restrict movement of the part. This occurs for two reasons—the pain caused by stretching on any attempt at movement, and later the fibrous tissue unites to the neighbouring parts, producing partial fixation and stiffness There is also an accompanying restriction caused by protective spasm of the neighbouring muscles, due to reflex action. Adequate remedial exercises and massage will prevent adhesion formation following a strain of muscular tissue.

Treatment.—

IMMEDIATE TREATMENT.—Initial aims are to control hæmorrhage and minimize the size of the hæmatoma, whilst making the athlete comfortably ambulant so that muscular imbalance is not brought about and he is psychologically benefited by minimization of pain and unnatural gait.

It is not always possible to be able to affect a strain of muscular tissue by means of cold, but the superficial structures such as the tendo Achillis will benefit. Ice packs, chipped ice, pads soaked in ether meth., evaporating lotions, or even immersion in cold water will all aid the more superficial lesion. With the deeper strain compression is essential, in the form of adhesive strapping or a normal pressure bandage. It is very much better to strap the complete length of the muscle if possible thus completely supporting the whole potential pulling area and also obviating any alteration in the origin and insertion of the muscle. Such a strapping will also prevent the forcing of the resulting effusion above or below the compression bandage, where it causes pain and inconvenience

A period of rest, ranging from 12 to 36 hours, dependent upon the severity of the lesion, must follow—whilst non weight-bearing exercises of a remedial nature must be prescribed and carried out hourly Such relaxation and contraction of the muscles against the compression of the strapping or bandage will cause a form of automatic self massage which

are obtained when treating soft tissue lesions if a moist heat is used. The swathed short wave electrode method gives rise to a moist heat the towel protecting the skin from injury, and gives a skin reaction similar to that obtained when hot water is poured over a towel tightly wrapped around the site of injury Conversely, the results obtained from using the damp pads of long-wave diathermy are disappointing

On the first two or three days the diathermy should not be too hot, and the total treatment session so far as short-wave treatment is concerned should be one hour per day Follow the heat with massage, commencing lightly and progressing to a deep type of friction massage given longitudinally and transversely The reason for the latter manipulation is because intramuscular scarring limits full broadening of the muscle, and exercises may not have the desired effect.

At the conclusion of the massage session graduated exercises should be given. Initially to mobilize and later to strengthen, the exercises have the purpose also of causing the muscle to maintain its tone and strength to a high degree. Preferably they should be of a non-weight bearing nature and should progress to weight bearing, both by means of body weight and weight resisted exercises. At the conclusion of this treatment session, the site of the lesion should be firmly supported by a compression bandage stretching preferably the entire length of the affected muscle Every effort should be made to make the patient walk as normally as possible, using sponge rubber padding strapping built up shoes, etc.

It is a sound method to let the injured athlete, at least once daily carry out mobilizing exercises whilst in a bath of hot water the added range of movement without pain has a big mental stimulus that goes a long way towards cutting down the disability period. Great stress is placed upon exercise following a muscular injury because the contraction and relaxation of the muscle cause a physiological action that enables the muscle to regain its tone and to become shortened, the hæma toma absorption is increased, free circulation of blood to the injured part and its immediate vicinity is encouraged, chemical changes following muscle activity take place, and adhesions are

factor in the rehabilitation of injuries to the limbs, but the speed of recovery is hastened by the use of anæsthetic injected locally followed by deep massage.

LATER TREATMENT —

Pressure Technique.—If a complete rupture is suspected, surgery is the obvious treatment, followed by some form of immobilization. The physiotherapist's task is then confined to keeping the athlete active whilst in immobilization by means of the 'treat and train' policy and later rehabilitation.

The principles of treatment for a strain of muscular tissue are to maintain such mobility as will allow the fullest painless contraction of the muscle to shorten the period of absorption and physiologically and psychologically to equip the athlete so that he can resume painless normal function as quickly as possible. These principles, of course, follow upon those initially recognized of controlling hæmorrhage and minimizing the size of the hæmatoma.

At the conclusion of the rest period, treatment can begin with the direct aim of promoting absorption of the hæmatoma, lymphatic absorption stimulating this factor as well as that of fibroblastic proliferation. Initially the scheme of treatment should not be too vigorous for fear of recurrent hæmorrhage, the severity of the lesion being the guiding factor. Possibly the most effective method of promoting hæmatoma absorption is heat followed by massage; this is certainly the case in the majority of muscular lesions. The difficulty of affecting deep-lying lesions by means of heat is solved by the use of short wave diathermy, possibly the only solution because of its penetrative powers.

Beginning on the day following the end of the rest period two, three or even four sessions of short wave diathermy are given to the area of the strain, the number being dependent upon the severity of the lesion. Improved results have been obtained by using malleable electrodes with a felt padding placed upon a towel lying against the actual skin, the whole being bandaged into a compact mass. It seems that there is some sort of enhanced heat concentration which gives better results than when the condenser type electrode is used. There appears to be some slight connexion here with the fact that better results

The emphasis on treating this type of case must be one of briskness the athlete must be soundly convinced that at last some efficient means of curing his injury are commencing He must not be encouraged to seek sympathy, to lie around being massaged and to have it all done for him, but he must be given adequate short-wave diathermy, followed by deep massage, and then the most vigorous scheme of active exercises worked out for him. These he will carry out at home, following hot water bathing at least thrice daily, and he must be inspired with the conviction that this is the *only* way in which he will be able to resume sport. Obviously, the more treatment sessions he undergoes the better, the more quickly will he respond, but his own handling of the situation at home is vital and he must be impressed upon that this is the case If necessary some form of strapping to the site of the lesion may help but the limp or faulty ambulation must be immediately eradicated he must be so supported by strapping, sponge rubber padding or heels, and built-up shoes, etc., so that he is able to walk in a normal fashion. There will have been enough chances for muscular imbalance to occur during his disability period, and the remedying of this factor will probably take as long as the clearing up of the actual injury

Case 34.—Jamaican sprinter of Olympic class, running in a 220 yards race on a warm June afternoon, felt a jab of pain at 75 yards and pulled a hamstring muscle at 110 yards. He continued the race in a limping style, finishing second but collapsed on crossing the finishing line. Compression bandage immediately applied from ankle to groin, and taken home in car with leg held in straightened position. Spent week-end sitting with it in similar position whilst carrying out non weight bearing exercises. On the Monday following (24 hours) began twice-daily short wave diathermy massage and exercise sessions Commenced jog trotting training on Thursday and began full training on the tenth day treatment being given throughout this period. Adhesive strapping support worn during all active exercise

From the second day there was marked oedema and swelling in the popliteal region but the injury responded rapidly so that on the twenty first day following injury he was placed second in both national sprint race titles.

Total disability period 16 days No training 4 days Light training 3 days.

prevented from forming by reason of the muscular movement not permitting the organization of lymph to take place between its surfaces.

Treatment and exercises can be stepped up until such time as the fullest degree of treatment with training can apply, the supporting strapping being used as long as the physiotherapist feels that there is a physical and mental advantage from its presence, or whilst the athlete gains confidence from its supporting presence.

Home Technique—If it has been possible to carry out the immediate-treatment routine the later steps should conform as closely as possible to those given above. In place of the frequent treatment sessions, the athlete should be instructed to carry out contrast baths, or hot towels followed by active exercises—these sessions to be carried out at least twice daily His rehabilitation will progress in a supervised fashion but will be carried out under the athlete s own initiative.

The injured sportsman who has not received any satisfactory immediate treatment, but who is seen when the lesion is still in an acute condition, should be instructed as to rest with non weight bearing exercises and the injury should be so strapped or supported as to give the maximum comfort. Later treatment should be as above. In all cases of home treatment there must be an emphasis on the application of heat and the adequate performance of progressive exercises. It is also a good idea for the injured man to be instructed to apply a hot water bottle to the lesion when in bed at night a more complicated but efficient method is home application of kaolin poultices.

The usual type of muscular strain seen in private practice however is that which occurred about three weeks previously and has received sketchy home treatment, or no treatment at all and not having satisfactorily cleared up the optimistic athlete comes along for higher guidance There is usually marked limitation of movement when walking, and a marked degree of joint movement on a reduced scale. There will possibly be swelling and pain on palpation and pain on movement beyond a certain modest degree. Adhesions will have formed and the athlete s mental condition will be at rock bottom!

Fig 27 —Case 39. Radiograph of the athlete showing the calcified areas extending from the origin of the rectus femoris on the anterior inferior iliac spine

Fig 28 —Case 42. Photograph of thigh showing the muscle formation when the quadriceps are contracted

Case 35—Professional footballer 35 years of age had suffered intermittently for four year period with chronic right adductor strain, following an injury incorrectly treated. As soon as football pitches became muddy this player found that the muscle was unable to last for the 90 minutes of play without becoming increasingly tired and painful as the game progressed. The six-day period between matches was fully occupied with treatment in an attempt to get him fit for the following week's match. This meant that his training suffered an important feature for such an older player and a vicious circle was created in that he was unable to train because of the injury and he became worse because the muscle group lacked the strength given by regular training

Rest was tried without success, short wave diathermy histamine, massage, stretching type manipulations, strengthening exercises, all were tried and attempts made to evolve a supporting strapping for this most-difficult to-strap area.

Following the manipulation under anæsthesia of a similar condition (but of much less severity) in another player the patient was persuaded to have a similar manipulation. This was carried out on a Wednesday he played 2nd Division football on the following Saturday and has since suffered not the slightest recurrence of the condition over a two-year period.

Case 36—International rugger player running with ball, felt a sharp pain in right calf as though someone had shot him He immediately lost all use in the lower leg and fell to the ground. Local anæsthesia was injected into the site of the lesion and supporting strapping applied from toe to knee For 24 hours the limb was rested and non-weight bearing exercises were carried out vigorously After this period, short wave diathermy and deep massage were given and the player encouraged to carry out easy jog trotting on grassland. Full training was possible in 5 days and he played again on the tenth day

Total disability period 9 days No training 2 days Light training 2 days.

Case 37—Professional footballer sustained slight strain of rectus femoris no clear recollection of any incident in which it was caused. Carried on full training whilst being given twice-daily sessions of short wave diathermy massage, and exercises for five days, at which stage the condition was almost negligible

Played football on the sixth day with no apparent ill effects, but noticed recurrence of pain on following day—had further six days treatment and carried out only light training for two days. The condition again cleared up but reasserted itself on the following Saturday on conclusion of the game.

Anæsthetic was injected locally on the following Monday and exercises were carried out with deep massage preceding this massage was performed twice daily for four days at the conclusion of which

period there was no pain or limitation of movement and there has been no recurrence since

Case 38.—Irish International football player complained of acute pain in both groins following a game. No history of injury condition appeared insidiously and became worse, so that last 20 minutes of play were difficult.

On examination, palpably sore area at origin of adductor resisted adduction caused pain Short wave diathermy and massage were given, with resisted adduction exercises Condition improved, but worsened on playing again. Histamine ionization was tried instead of short wave diathermy but with no improvement. Bilateral manipulation under anæsthesia almost 100 per cent improvement for three weeks after which the condition seemed to return in greater severity

Treatment was resumed, but was replaced after four days by a progressive scheme of abdominal strengthening exercises from which the patient began to benefit after about four days of thrice-daily sessions. Exercises were carried out thrice daily for nine weeks, up to end of football season no recurrence of pain and marked improvement in player's mobility and kicking

Case 39.—Coloured Jamaican Olympic sprinter complained of cramp in left quadriceps region after 100 metres sprint in Paris Two days later in London he took part in a further meeting, during the course of which he had to run races of 100 and 220 yards. During the 100 yards he felt some discomfort in the same area, but in the 220 yards he was pulled up in agony as muscle strained in the left thigh.

An enthusiastic helper lacking adequate medical qualifications immediately vigorously massaged the area, which was in a state of spasm and extremely painful. No further treatment was given and athlete went home walking with extreme difficulty Next morning considerable swelling was present over the lower part of the quadriceps and movement of the knee was extremely painful. Reported to masseur who gave half an hour's faradism to the quadriceps followed by massage. This took place daily for three weeks after which the athlete felt obliged to resume some form of training this he did with difficulty as the condition was not greatly improved. After a week of training the injury had improved to a certain degree and the athlete was persuaded rather against his own better judgement, to compete in an international meeting in London.

During the 100 yards race the muscle strained again, tearing some fibres of the rectus femoris at its origin on the anterior iliac spine. It is not known what treatment was given at this stage but within a few weeks there were definite signs on X ray examination of myositis ossificans traumatica in the substance of the rectus femoris immediately below the lesion. (*Fig* 27)

The player was treated with short wave diathermy hot and cold bathing, massage, and exercises for three weeks and then appeared to be recovered. He satisfactorily passed a fitness test and subsequently played on the following Saturday with no adverse reaction at first, but during the later stages of the game he found that he could run in a straight line, but turning or balancing on the injured leg whilst he kicked with the other foot caused considerable pain. He had the thigh strapped from knee to groin during this game.

On the following day the thigh was sore to the touch and movement was slightly painful, but it improved overnight so that he played in a practice match on the following day Halfway through the game he was unable to continue because of pain and inability to put his body weight on the injured limb In spite of two weeks treatment by means of short wave diathermy hot towels, massage, and exercise the condition did not improve. Subsequently the player was sent along to the local hospital for examination by the orthopædic surgeon, who ordered radiographs and finally had the player admitted at once.

The injury was diagnosed as a rupture of the sheath of the rectus femoris and subsequently an open operation was carried out to repair the lesion. The usual rehabilitation followed and after fourteen weeks the player returned to the team and had no further trouble during a six years period.

Note.—This case history has been obtained from the patient himself and was not personally encountered by the author

This athlete subsequently had various forms of treatment from innumerable people, some qualified medically and others not so, but it was not until two seasons later that he managed to so adjust his action to counter the muscular imbalance resulting from this inflexible area in the muscle tissue, and to return himself to Olympic form.

Case 40—Professional footballer complained of bilateral adductor strain, insidious in onset but becoming worse after exertion. The usual treatment for strained muscles was given, short wave diathermy massage exercises, etc. and there was an attempt made to strap the region to enable the man to play Eventually manipulation under anæsthesia was advised and carried out by an orthopædic surgeon, but without very much success. Further examination by the surgeon revealed that the player had a congenital malformation of the heads of the femora causing an uneven strain to be placed upon the adductors when certain strains were undergone. No form of exercise or treatment, other than rest, has had more than a slight temporary effect of relief on the condition.

Case 41—Professional cricketer suffered intermittent pain from what appeared to be a strain of his left adductors, although it did not seem possible to reveal any painful areas by means of palpation. The inability to localise the lesion raised difficulties in treatment and the player was sent to an orthopædic surgeon.

The surgeon was of the opinion that his symptoms came from a strain of the psoas iliacus. The player indicated the region of the lesser trochanter as the site of pain, and pain could be elicited by opposing flexion of the hip and by opposing adduction. The surgeon discovered deep tenderness in the left iliac fossa and over the psoas. He therefore came to the conclusion, in the absence of any history of injury that the player had strained his psoas and had a forced abduction injury occurring as the result of a sudden stretching movement whilst playing

Checks were made to ensure that there was no form of hernia, and a radiograph was taken of the lumbar spine. The surgeon manipulated the leg and hip under anæsthesia with the object of freeing the muscle from any structures to which it had become adherent.

The result was instantaneously successful, the player resuming playing two days after the manipulation, and has continued for two years without recurrence.

Case 42.—Professional footballer at the conclusion of a match on a wet day when the ball was very heavy and muddy complained of an ache in his quadriceps. On the following day this became worse, and when he attempted to kick a ball during training on the following few days, he suffered considerable pain. On examination there was a palpably painful area at about the middle of the rectus femoris and passive knee flexion was limited and painful contraction of the quadriceps against resistance also caused pain. (*Fig* 28)

to the infiltration of the tissues by the inflammatory exudate penetrating throughout the tissues and stretching and pressing upon various structures, but particularly nerve-endings. Thus there exists vascular changes, the formation of an exudate, and the process of repair, and to these pathological phases the clinical symptoms are due

The general effect of inflammation on muscles is to cause them gradually to lose their tonicity, irritability, elasticity, and contractibility, allowing a degree of atrophy to follow with corresponding loss of function Joint structure, such as ligaments and capsules, become stretched and loose in their texture, so that their supporting capabilities are lessened A contusion causes œdema, a condition of tissue saturation caused by an alteration in the rate of the transudation of lymph from the blood stream to the tissues and its removal. When the tissues are thus saturated with lymph, they become swollen and stretched to a degree depending upon the structure of the particular tissue, for instance the eyelids and the scrotum, where the tissue is lax, show considerable swelling when injured. The strong denser tissues resist the stretching forces more than the loose, vascular areolar tissue which fills the interspaces of the muscles, tendons, and ligaments

As the result of a contusion, blood escapes from the torn capillaries and veins into the tissues, undergoes certain definite changes, and ultimately becomes absorbed. But before this end result takes place, colour changes occur ranging from brown, blue, and yellow to green. This phenomenon is due to the chemical and physical transformations of the hæmoglobin. The extravasated blood sometimes extends for a considerable distance through the tissues positive signs of its presence may not be seen for some days after the injury when the bleeding is in the deeper muscles and under fasciæ. Lymphatic vessels may be ruptured allowing lymph to seep into the tissues, this escaping fluid forms the inflammatory exudate The exudate fills up the interstices of the tissues the amount and distance to which it may travel largely depend upon the looseness of the texture of the affected tissue and the severity of the injury The presence of this lymph or plasma in a somewhat altered form as a result of trauma is important, because if allowed to

CHAPTER IX

THE TREATMENT OF CONTUSIONS

A CONTUSION is the crushing of the soft tissues of the body by some violent external force, without any break in the continuity of the skin. It is an actual bruising of tissue usually sustained in a body-contact sport such as football, rugby, ice hockey or speedway, caused by a kick, blow, or push or when an athlete falls and heavily strikes the ground or some artificial obstacle such as goalposts or a barrier. It is an immediate injury rarely showing any time lag, immediately following the actual contact of body against body or body against object, there is acute pain and loss of function of the part *involved and those parts adjacent to it.* In a superficial case there will be a certain degree of cessation of pain within a few minutes so long as the athlete continues to keep moving, thus causing the part to remain heated and the blood to continue to course speedily through it. As soon as he ceases active movement, pain and stiffness will occur with accompanying loss of function. In the majority of cases swelling appears swiftly and in a severe case the internal hæmorrhage will continue as long as active movement is continued.

Trauma acts as an irritant and produces the pathological process of inflammation in the tissues directly implicated. During this process a succession of definite changes occurs, resulting from the presence of the irritant, the end-result of which is directed towards the removal of the irritant and its products and the eventual pattern of repair. The classical clinical symptoms of inflammation are heat, redness, swelling and pain leading to loss of function—these are merely the clinical evidence of the underlying pathological changes resulting from irritation of the tissues. The symptoms of heat and redness are due to the increase of blood to the injured part and its immediate vicinity, the swelling and pain are due

to the infiltration of the tissues by the inflammatory exudate penetrating throughout the tissues and stretching and pressing upon various structures, but particularly nerve-endings. Thus there exists vascular changes, the formation of an exudate, and the process of repair, and to these pathological phases the clinical symptoms are due.

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CHAPTER IX

THE TREATMENT OF CONTUSIONS

A CONTUSION is the crushing of the soft tissues of the body by some violent external force, without any break in the continuity of the skin. It is an actual bruising of tissue usually sustained in a body-contact sport such as football, rugby ice hockey or speedway, caused by a kick, blow, or push or when an athlete falls and heavily strikes the ground or some artificial obstacle such as goalposts or a barrier It is an immediate injury rarely showing any time lag immediately following the actual contact of body against body or body against object, there is acute pain and loss of function of the part involved and those parts adjacent to it. In a superficial case there will be a certain degree of cessation of pain within a few minutes so long as the athlete continues to keep moving, thus causing the part to remain heated and the blood to continue to course speedily through it. As soon as he ceases active movement, pain and stiffness will occur with accompanying loss of function. In the majority of cases swelling appears swiftly and in a severe case the internal hæmorrhage will continue as long as active movement is continued.

Trauma acts as an irritant and produces the pathological process of inflammation in the tissues directly implicated. During this process a succession of definite changes occurs, resulting from the presence of the irritant, the end result of which is directed towards the removal of the irritant and its products and the eventual pattern of repair The classical clinical symptoms of inflammation are heat, redness, swelling, and pain leading to loss of function—these are merely the clinical evidence of the underlying pathological changes resulting from irritation of the tissues. The symptoms of heat and redness are due to the increase of blood to the injured part and its immediate vicinity the swelling and pain are due

removal of the irritant which is affected mainly by the exudate and then, when the inflammatory circulatory changes are completed, the formation of the exudate ceases and the repair processes begin

One of the most interesting complications of muscle contusions is that of *myositis ossificans traumatica* or traumatic subperiosteal ossification, known as the occupational disease of footballers' Its causative factor is in doubt, Eliason* states that it is generally accepted as an ossified hæmatoma. The original trauma causes a deep muscle contusion—so deep that a number of periosteal cells are loosened and float into the hæmatoma, during the process of repair these cells proliferate, laying down calcification in the hæmatoma. Blundell Bankart says that myositis ossificans is due to the deposition of calcium and the formation of bone in the muscle, and that it is not due to the invasion of muscle by spreading periosteal osteoblasts This view is supported by the fact that deposits of myositis ossificans occur at least an inch away from the insertion of the brachialis anticus in cases involving the elbow joint. Watson Jones† says that the condition is entirely within the control of the surgeon. It is an avoidable complication and its progress can always be arrested. He discounts the old theory that osteoblasts escaped from the bone and wandered into muscles, laying down bone in their course The new bone formation occurs only within the limits of displaced periosteum and it is nothing more than the ossification of a subperiosteal hæmatoma. This contention is also supported by Greig ‡

The reason for its prevalence in some cases but not in others is accounted for by Tucker § who suggests that it might be due to the fact that some people have a higher blood-calcium than others

The late Professor McMurray stated conclusively that if there is any predisposition to the condition, it is immaterial what treatment is prescribed—the condition will occur anyway

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* Eliason E L. (1928) *Int. Clin* ii 91

† Watson Jones R. (1943) *Fractures and Joint Injuries* vol. 1 66. Edinburgh E & S Livingstone

‡ Greig (1931), *Surgical Pathology of Bone* 170. Edinburgh.

§ Tucker, W E. (1935) *Injuries and Their Treatment* 78 London Lewis

become stagnant it is a potent factor in the production of adhesions between contiguous surfaces. Wherever tissues are inflamed and are bathed in the fluid products of inflammation for a lengthy period, plus the aggravating factor of the parts concerned being kept in contact by rest during the inflammatory process, adhesions are certain to form. Pain, which encourages the patient to keep the inflamed part still, is one of the main causes in aiding the promotion of adhesion formation, because the lack of motion in the injured part allows time for the exudate to become organized whilst the opposing surfaces are in apposition.

Adhesions have a great capacity for doing serious damage, because of their power in binding structures of all kinds together and finally contracting The importance of early preventive measures to eliminate adhesions is emphasized when it is considered that in the early stages of formation the adherent surfaces are easily separated by means of voluntary or passive movement. Another of the principal aims of treatment is early mobility and the return of near normal function of the parts that are injured or are connected with those parts. The reason for this is that in a tissue such as muscle where the function is to contract and relax, nutrition is very largely dependent upon this very function. By means of contraction and relaxation of a muscle a considerable passage of blood through the muscle is ensured therefore any lessening in the power of the muscle to contract and relax materially affects its nutrition. Loss of function by lessening blood-supply may cause atrophy of muscle, which at the same time causes diminution of function, thus forming a vicious circle.

When one considers the pathological changes taking place in inflamed tissue it appears to be a common sense feature of treatment for the physiotherapist to guide and control these processes rather than to interfere with them. By means of early control of hæmorrhage and later methods aimed at aiding absorption, the vascular changes taking place during the inflammatory processes can be so directed as to benefit the injured parts whilst preventing the disadvantages that arise from prolonged and exaggerated circulatory activity The processes of repair in contused tissue include initially the

The first clinical evidence of the condition appears a few weeks after the injury as an indurated mass palpable in the muscle. Radiographically, there is a cloudy shadow, which gradually becomes denser and smaller as calcification and absorption proceed. It can generally be considered that any muscle contusion that does not respond to immediate cold application, compression bandaging, heat, and massage with exercises, but remains hard, firm, and tender, with decreasing range of active and passive movements, should be suspected of myositis ossificans The treatment should be directed at keeping the hæmatoma as small as possible by temporary immobilization of the part in a position where the torn periosteum can fall naturally back into place.* All massage and heat should be stopped, with certain provisos mentioned later, and rest with light non weight bearing exercises carried out.

The condition most applicable in this chapter, and a more frequent occurrence than is to be expected, is the contusion to the quadriceps giving rise to calcification. Contrary to generally-accepted principles of heat treatment in this condition, it has been found by the author that the application of moist heat by means of hot towels has a remarkably beneficial effect. A typical case is outlined in *Case* 43 Most authorities state that all myositis ossificans cases heal those in the belly of a muscle with perfect functional results (the bony area remains and firmly attaches itself to the shaft of the bone) those cases that occur in the origin or insertion of muscles in the region of joints always interfere with a perfect functional result and usually leave a residual disability There is a definite tendency for bone to re-form after an operation, as the periosteum must of a necessity be again injured during the actual operation. This tendency for recurrence is particularly marked in cases involving the elbow joint. Operation should not be under taken until final ossification has occurred and then only if the result is a bony block limiting movements Operation where no pain or functional impairment exists is futile to the athlete whether the mass is removed or allowed to remain, balance

* Zieve, L. E. (1950), *Aids to Orthopædic Surgery and Fractures* 41 London Baillière, Tindall & Cox.

From long experience in the sports world the medical officers of the Arsenal Football Club report that they are doubtful if it can be avoided except by complete rest.* In the experience of the author there is no prior means of recognizing that an injured player is susceptible to the condition, and the usual treatments for contusions obviously encourage the proliferation of the calcification. But as it is not possible, because of the speed and priorities required in top-class sport, to let an injury such as a quadriceps contusion remain untreated for some days to ensure that calcification is not commencing—a risk is present that must be recognized and taken.

Myositis ossificans can occur in the adductor or quadriceps groups, sometimes becoming so extensive that hip and knee movements are seriously impaired. Usually in these cases it follows repeated strains, causing rupture and intramuscular hæmorrhage, but a single, hard blow will frequently set the calcifying processes in motion. Most of us are acquainted with this condition in the region of the elbow joint. Thorndike† says that such cases should not be operated upon until one to two years have elapsed since the healing process, or until the activity of these loosened periosteal cells is dormant. He feels that it is a most exceptional case which warrants operation, one which causes marked interference in function. The complication of myositis ossificans in the structures of the elbow joint is likely and is nearly always incapacitating in some form or other, as is the rule when the condition occurs near any joint. If the condition occurs in the belly of a muscle, along the shaft of a bone, it is very rarely limiting. It is not safe to manipulate an elbow joint, except in the case of tennis elbow, for at least three months after an injury. It is considered far better to rest the joint completely for two to three weeks and then to obtain movement by the patient's own gentle active movements. Supraspinatus tears or strains sometimes develop myositis ossificans in the tendon of insertion, which may require operative removal.

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* Pepper, W. G. S., Fripp, A. T., and Tanner, W. E. (1950). *The Practitioner*, 164, 298.

† Thorndike, Augustus (1949), *Athletic Injuries—Prevention, Diagnosis and Treatment*, 89. Philadelphia: Lea & Febiger.

normal as long as the condition is not allowed to stiffen up by reason of a rest period Light massage with Capsicum Vaseline (Chili Paste) will give a superficial feeling of warmth and do a certain amount towards deadening the pain. It has been the earnest hope of the author that at some time a preparation would become available that would be capable of being lightly rubbed into a contused area and would give a numbing or anæsthetic effect. Experiments have been carried out with ointments used in cases of hæmorrhoids but without success.

A severe contusion will cause sufficient loss of function to withdraw the player from the game at the time of its occurrence He should be placed in a comfortable position so as to take tension off the injured part. The lesion should be covered with a compress of ice either in chipped ice or ice water form, or pads soaked in ether meth., or just cold water This bathing should be carried on for at least half-an hour The part should then be covered with a lint or gauze pad soaked in a liniment formed of aconite belladonna, and chloroform, an old but highly effective counter-irritant. It is a sound policy to warn the patient that this will cause a short period of intense and sometimes uncomfortable heat.

A compression bandage should be applied to the area and the patient told to rest the part for 36 hours, whilst carrying out non weight bearing exercises—instruction should be given in these exercises before allowing the patient to leave for home The idea of these exercises is, as already mentioned in this chapter to retain muscle tone, to give nutrition to the affected muscle and to prevent congestion of the injured area with fluid. As an alternative to the Liniment A.B C in cases of superficial contusions, kaolin poultices may be applied.

LATER TREATMENT —

Pressure Technique —

1 *Muscle contusions* At the conclusion of the 36-hours rest period, the treatment sessions may commence. The aims of treatment are (*a*) to restore the normal functions as quickly as possible thus preventing muscular imbalance, preventing adhesions, and aiding the athlete s mental outlook (*b*) to limit the size of the hæmatoma (*c*) to encourage absorption of the

has to be regained and muscle tone restored. Operation at an early stage simply disseminates the hæmatoma, thus further extending the ossification.

A certain degree of caution must be used when massaging gross contusions of muscle during the early stages of treatment the actual contused area should be avoided and massage confined to above and below the lesion with a view to improving local circulation. In a potential case of myositis ossificans rubbing irritates and stimulates the production of more and heavier periosteal-cell activity To conclude, Watson Jones* has stated that if displacement of the periosteum is prevented and extensive hæmatomata not allowed to occur, the complication is never seen.

Another secondary condition associated with contusions received in sport that is frequently encountered is that of *periostitis* Usually it attacks the lower third of the shin (anterior border of the tibia) because in that region the circulation is less efficient than higher up the limb This traumatic periostitis is sometimes a delayed condition in that it does not give rise to trouble until the original injury has become but a mere recollection. Tenderness and irregularity of the affected area will be found, and sometimes a spongy patch will be palpable or even sufficient effusion to cause fluctuation. Adherent scarring will sometimes form but this is not of importance because the periosteum is attached to bone, which itself is motionless The treatment found most effective is heat, deep massage of an effleurage type, and compression strapping, sometimes with a counter-irritant. *Case* 45 is a typical example of the treatment of this condition.

Treatment.—For the purposes of clarity contusions may be subdivided into four classifications (1) Muscle contusions (2) Bone contusions (3) Joint contusions (4) Nerve contusions. All four classes can be either superficial or severe.

IMMEDIATE TREATMENT.—The slight contusion, if not on the face but on a movable area such as the thigh or calf can be speedily treated on the touchline so that the player is able to carry on with the game his ability to function being almost

* WATSON JONES, R. (1943), *Fractures and Joint Injuries*, vol. 1 66. Edinburgh E. & S. Livingstone Ltd.

ossificans traumatica, and the skin becoming too sore to tolerate further treatment The former point has already received attention the skin soreness is countered by treating the skin after each treatment with calamine, caladryl, etc., or with some sort of skin food such as Nivea Cream. This must of course be washed off with spirit before the next session is given. The injured athlete needs to be convinced that this type of injury will inevitably progressively improve with treatment and exercise barring the factors of myositis ossificans traumatica and skin soreness. He must also be told when the time approaches for a try-out, when he is considered more-or less fit to play again, that the area of the lesion will be tender to the touch for some time, but that functional ability will be normal and there is no danger of aggravating the injury by movement—the more movement the quicker the recovery

2. *Bone contusions* Bony parts exposed to injury in sport frequently suffer and most athletes can recall minor aches and pains in the hands and elbows, for example, when the bone has been bruised. This can be an excruciatingly painful condition as when a cricket-ball is stopped on the finger tips or when the lower part of the shin is hurt by a kick or a blow from a stick, etc. The condition of traumatic periostitis has already been mentioned, and this to a degree, covers bruising to the bone. The principal treatment that is effective is deep heating preferably by short wave diathermy, and the part must be protected from further injury by means of sponge rubber or felt padding In the case of shin soreness, caused by constant training or running on hard surfaces such as a road or gymnasium floor, treatment frequently has little effect. Massage with warm olive oil sometimes alleviates the condition but often rest is found to be the only cure. However, this comes more under the heading of a muscular strain, as it is thought to be a minor lesion of some of the fibres of tibialis posticus

3 *Joint contusions* This usually results in a bruising of the joint capsule, resulting in an effusion both from the minute blood vessels within the capsule wall and from the synovial membrane lining the joint capsule As with other contusions

hæmatoma and (*d*) to rebuild any loss of muscle strength during the period of disability

Aim (*a*) is achieved by means of strappings, compression bandaging sponge rubber padding and heel, etc., in addition to which the progressive treatment will obviously cause the lesion to become less tense and painful. Aim (*b*) is covered by the initial steps of cold application, pressure bandaging, etc., and the non weight bearing exercises during the *rest* period which are a form of auto-massage against the elastic pressure of the bandage. Aim (*c*) is carried out by treatment sessions performed perhaps four to six times daily, dependent upon the severity of the injury and the patient's tolerance. Aim (*d*) is achieved by means of weight resisted exercises during the later stages of rehabilitation plus the treat and train policy which is the automatic accompaniment of all treatment given by the author

The treatment sessions consist of heat, massage, and exercise —the heat represented by short-wave diathermy hot water bottles during night hours, and kaolin poultices applied at the conclusion of the last treatment in the morning and the last treatment in the afternoon and evening Massage should aim at improving local circulation above and below the lesion, and in improving the mobility of the area, both factors which aid in absorption of the hæmatoma. The exercise should be of a non weight bearing nature initially progressing to strengthening exercises later in addition to the mobility exercises. Training should be carried on as far as is physically possible, preferably with the other players to give interest and incentive. Thus the day's programme would be a specified number of sessions beginning with short wave diathermy followed by massage and exercises then a session with hot towels, more massage and exercises and if the skin will tolerate it a kaolin poultice applied to give warmth and aid circulation during the lunch period and in the evening after treatment. After each session a supporting pressure bandage must be applied, as the comfort given to injured tissue by support greatly facilitates normal movement, with all its physical and psychological benefits.

The two factors to be watched when carrying out pressure treatment of a muscle contusion are the inception of myositis

must be alert for the slightest traces of calcification of the hæmatoma a lessening of the degree of painless movement being the danger signal.

ADDENDUM

In January, 1954, Lloyd Percival, General Adviser to St. Michael's College (Canada) Ice hockey Team, read a paper to the Eastern Section of the United States Athletic Trainers' Association on the treatment of the 'charleyhorse' or contusion to the quadriceps. Following upon conversations with Dr René Milan, a French physiologist, and in conjunction with Dr A. H. Steinhaus, of George Williams College, Chicago, and Dr K. H. Slocum of the Mayo Institute, experiments were carried out in the uses of ascorbic acid for muscle soreness A technique of treatment was evolved which is given herewith the author has carried out experiments in this field but insufficient data are as yet available to give a personal opinion of the effectiveness of the treatment.

During Play—Players receiving hard blows on their thigh area are instructed to sit with their heel tucked underneath their buttocks when resting on the bench between sessions of play This is done in order to keep the thigh area well stretched and to prevent bleeding and contraction of the muscle. As soon as the player is in the treatment room, ice packs are applied keeping the thigh muscles in a stretched position by bringing the heel up to the buttocks Every now and then the player moves his leg for 20 or 30 seconds.

After the Game—As soon as the game is over, an ice pack is placed over the injured area and the stretching procedure is continued. At the same time the player is given 600–1000 mg of ascorbic acid. The athlete takes this in a glass of water The athlete is then told to move his leg being helped if the leg is very stiff or sore. He then begins walking moving onto deep knee bending and leg lifting in order to give the muscle area a good exercising He is told to keep the leg in use as much as possible before he goes to bed. If the injury appears to be severe, a pressure bandage is placed over the area when the ice treatment is finished.

the immediate treatment is control of the effusion by means of cold application and pressure bandaging, with shaped pieces of sponge rubber or felt over the areas most likely to be saturated with fluid exudate The later stages of treatment are as for muscular contusions.

4. *Nerve contusions* These injuries usually occur in exposed areas, such as the head of the fibula around which runs a branch of the sciatic nerve. Such a contusion will cause pain down the course of the nerve, lasting from a few seconds to a number of hours Sometimes a temporary paralysis will occur and odd sensations such as numbing or pins-and needles will be felt. It is frequently more important to treat the mental angle of the case than the physical, as the athlete becomes extremely alarmed when he finds he is apparently paralysed, and has to be reassured frequently

The treatment is rest and heat, in the form of short wave diathermy, hot towels, hot water bottles, or kaolin poultices. It is important not to massage over the actual site of the irritated nerve, and when sport is resumed it is best to have some sort of felt or rubber padding as a protection against further injury

Home Technique—Whether or not the immediate treatment has been as laid down, the condition will eventually clear up but without the ideal beginning the disability period will naturally be longer The emphasis must be on securing a normal gait or movement, so that the patient is not further handicapping himself during the periods between treatments by hobbling around. Strapping padding a sponge rubber heel, or built up shoes can be the means of securing this end, which is the most vital step in the treatment of contusions by means of the home technique.

Between each treatment session the limb must be supported by a crêpe bandage, and the patient instructed in its correct application. The actual treatment should approximate as nearly as possible the Pressure Technique, and the patient adequately instructed in home sessions of hot towels, hot water bottles at night on the area of injury home exercises, and padding protection to prevent aggravation of the injury In addition to suitably instructing the patient, the physiotherapist

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Next Morning.—The athlete is again given another 600–1000 mg of ascorbic acid and continued movement. If the area is very sore the muscles are stretched through manual manipulation and the athlete begins to exercise the limb on his own. As soon as possible he is made to skate again. Heat and deep massage are also used either singly or both together. If the athlete does not have to play the day following his injury he does lots of skating but no body-contact work. If he has to play the area is protected with adhesive foam rubber.

Results.—A careful analysis of the results of this treatment shows a tremendous improvement over the 1952/3 season. The report says: So far (after 40 games) we have not lost one player for any game due to a charleyhorse injury. So far more than 100 charleyhorse injuries have been treated in every case the results have been considered excellent. The medical consultants all agree that the history of each injury indicates an improvement rate far greater than has hitherto been expected.

Controls.—In an effort to establish some sort of understanding regarding exactly what phase of the treatment is producing these results some injuries have been treated without ascorbic acid. In every case, the indication has been that recovery is slower. Though there appears to be every reason to assume that ascorbic acid is helpful in the treatment of charleyhorse injuries, it is felt that it will be necessary to conduct a careful testing programme before anything definite can be stated about the exact value of this treatment. Though the indications are that much of the success of this treatment is due to ascorbic acid, it is also felt very strongly that the stretching and movement phase makes an important contribution. It is thought that continued movement immediately following infliction of the injury is very helpful in the treatment of a charleyhorse.

In analysing the results obtained with the new treatment as against previous methods and the methods used by others who have been questioned, it is apparent that the athlete seems to recover full use of the leg more quickly without as much soreness, when mobility is sustained. It has been noted that

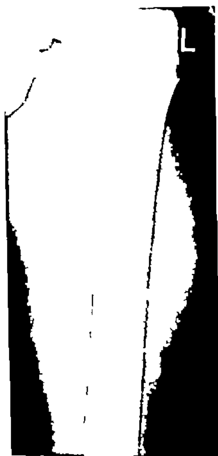


Fig 29.—*Case* 47.—Radiograph showing a fairly large calcifying haematoma in the outer side of the middle and upper third of the left thigh, and a small subperiosteal haematoma in the outer border of the middle third of the femur (*Sept* 4 95)



Fig 30.—Same case Show calcification in the soft tissues parallel to the anterolateral aspect of the left femoral shaft t th junction of the pper and middle third. This is the result of periosteal damage w th resulting ossification in the haematoma For progress compare the earlie film (*Fig* 29). (Sept. 2 95)

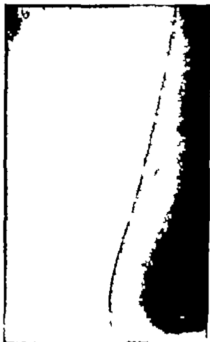


Fig 3 —Same case This film shows, on comparison with the last and the original film, the extent of the calcification, which appears to be reduced, whilst the density has increased to some extent The report of the radiologist states that "on the whole I think gradual improvement is taking place but I think active treatment should still be avoided, though hyperaemia may be encouraged" (Oct. 29 1951)

athletes who play after having received a charleyhorse injury have less trouble afterwards than those who retire from the field after the injury has occurred

Ascorbic acid in the treatment of other contusions and some sprains and strains has been used. Although a careful analysis of results has not yet been made, it seems at this time that the treatment is getting the same excellent results as in the charley horse type of injury

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Mr W E. Tucker, of the Mayfair Clinic for injuries, has been using streptokinase and streptodornase injected into hæmatomata to cause them to liquefy Hyalase has also been used to promote absorption in hæmatomata and effusions being generally introduced under local procaine anæsthetic. Definite information as to results is not available, but it is understood to be favourable.

Case 43 —Ice-hockey player struck by an elbow in the right eye a few seconds before the end of the game On leaving the ice the eye was beginning to swell, but immediately he entered the dressing room a cold compress formed of cotton wool soaked in ether meth. and placed in a plastic bag was applied to the eye This continued for half an hour and was then bandaged in place whilst the player had a bath. By the time he had dressed and was ready to leave for home, the eye was almost normal, with no swelling or discoloration. No further treatment was required and he played the next evening

Case 44.—Professional footballer received a blow in the eye during the course of a game The eyebrow immediately became extremely swollen and overhung the eye. He continued playing until half time when crushed ice was applied and the effusion was treated by means of an attempted aspiration. This was not successful, as the effusion appeared to be too viscid to be able to be carried through the bore of the hypodermic needle. He continued playing for a further forty-five minutes during which time the swelling did not become any worse but did not improve.

At the conclusion of the game the swelling was lanced and a certain amount of blood was extracted. A pressure bandage was applied and the player given codeine and told to go straight to bed. After a 36-hours rest period, short wave diathermy and light, stroking type massage was given in an attempt to disperse the effusion. This was carried out thrice daily and hot water bathing was carried out by the player in between treatment sessions and at home.

The player carried on in full training during the entire period of treatment, but was unable to play for ten days because of considerable

tenderness over the frontal bone which made it impossible to head the ball. The player wore a pad and light pressure bandage for two or three days but this was then discarded on account of its conspicuousness. After five days no further treatment seemed necessary as the effusion was dispersed and treatment was not considered necessary for the frontal bone tenderness

Total disability period 10 days No training missed Games missed 3 (period when mid week games were also being played, otherwise only 1 game would have been missed)

Case 45 —County cricketer received cricket ball in face immediately below right eye. The ball was hit by an Australian Test batsman from a range of three yards away from the victim! A large swelling occurred almost immediately and the eye was thus almost instantaneously closed. Owing to lack of medical facilities, a block of ice-cream, suitably covered by sterile gauze, was applied to the contusion. Later cracked ice was obtained and used in its place.

The effusion was extremely large and discoloured, and the skin was slightly broken in two places. The cold compresses prevented any further swelling but did not appear to reduce the effusion very much. As the player was a key bowler and was urgently required for that day's play every step had to be taken to return him to the game.

Leeches were obtained from the local hospital, and applied to the contusion—a piece of lint being placed on the face with a round hole cut immediately over the effusion, on which a small drop of milk was placed. In about half an hour the leeches had dropped off, apparently gorged, and the effusion was reduced to a large discoloured patch. The player was able to return to the game after lunch and bowled successfully No further treatment was required.

Disability period 2¼ hours.

Case 46 *—In February 1935 a famous Arsenal F C. outside right collided with a photographer during a match and injured the upper and inner part of his left thigh. In March, 1935 there was a hard mass in the upper part of the adductor longus, but no opacity was seen in a radiograph. A month later the X ray showed a large ossifying mass He was also a professional county cricketer and was allowed to play in first-class cricket, using a box to protect the upper part of his left groin when batting X ray examination four months later showed an ossifying mass attached to the pubic bone at the site of origin of the adductor longus. The smooth free end projected under the femoral vein and was palpable under the skin. A month later at the end of the cricket season, the piece of bone was removed with a chisel. He resumed first-class football in the middle of October 1935

* Reprinted from the *Practitioner* 1950 April. "Injuries to the Professional Footballer" by W G S Pepper, A. S Fripp and W E Tucker.

Case 47—Professional footballer, received hard kick on the lateral aspect of the left thigh during pre-season training practice matches. Treated as normal contusion, but no specific immediate treatment given. Radiant heat massage, and exercises were given two or three times a day for four days, but the injury continued to be troublesome although it apparently only had a nuisance value. Unable to play on the following Saturday and range of knee flexion noted to be slowly decreasing

Myositis ossificans traumatica suspected and treatment accordingly modified to consist only of light exercise and twice-daily bathing in hot water At the end of the second week a hard mass was palpable on the anterior and lateral aspect of the quadriceps and subsequently X rays were taken which revealed a fairly large calcifying hæmatoma in the outer side of the middle and upper third of the left thigh and a small subperiosteal hæmatoma could also be seen in the outer border of the middle third of the femur probably involving the vastus externus muscle (*Fig* 29)

The player continued on twice-daily hot water bathing and light non weight bearing quadriceps exercises, whilst carrying out daily training in the form of body-building exercises in the gymnasium. Seventeen days later further X rays were taken which revealed calcification in the soft tissue parallel to the anterolateral aspect of the left femoral shaft at the junction of the upper and middle third (*Fig* 30) At this stage the surgeon in charge of the case ventured an opinion that the man would not play football again until Christmas—four months distant.

The treatment was continued as above a supporting elastic bandage being worn whenever weight bearing took place. On the twenty-first day training was expanded to include gentle trotting with permission of the surgeon. The palpable mass was much less evident and the condition appeared to be clearing up well On the twenty-seventh day the player was in full training and on the thirty fourth day following discovery of the ossification he again played football, with permission of the surgeon.

On the fifty-second day following injury he was again X rayed and on comparison with the previous films the extent of the calcification appeared to be reduced but the density had increased to some extent (*Fig* 31) The radiologist, not knowing that the man had been playing League football for three weeks, recommended that active treatment should still be avoided although hyperæmia could be encouraged!

It is three and a half years since this incident, and the man has suffered no further trouble with this leg although his predisposition to the condition is emphasized when it is told that two further contusions on the opposite leg have both shown signs of calcification and have had to be treated in a very conservative fashion.

Total disability period 6 weeks No training 3 days Light training 4 weeks Games missed 7

Case 48—Athlete, competing in 2 miles steeplechase event, mis-hurdled and sharply hit the outer side of his lower leg against the hurdle. He immediately lost all power of movement and almost all sensation in the lower leg and collapsed to the ground. He complained of numbing and inability to put his weight on the injured leg

On examination he appeared to have contused the external popliteal nerve in its course around the head of the fibula. He was told of his injury and reassured as to prognosis. The usual immediate steps were taken, cold compresses and a pressure bandage, and he was told to rest the injury for 24 hours whilst carrying out gentle non weight bearing exercises On being seen again in 36 hours the numbing and temporary paralysis had passed off leaving a tender and discoloured area over the head of the fibula. This was treated by short wave diathermy kaolin poultices and exercises but no massage, for four days. At the conclusion of this period little trouble remained and the man continued training without further incident.

Total disability period 5 days Training missed 4 days.

Case 49—County cricketer received hard knock from cricket ball on anterior border of the right tibia. No immediate treatment was given and little notice taken of the injury at the time. Two days later he had a swollen, spongy area about 2 in. square on the anterior aspect of the lower part of his leg On palpation it was exquisitely tender but did not appear to limit his movements at all.

Short wave diathermy was given, and a kaolin poultice was applied with a pressure bandage this routine continued thrice daily for three days. Occasionally the short wave diathermy was replaced by histamine ionization, and once or twice a dressing of Liniment A.B.C was applied as a counter irritant.

During his entire disability period he was able to continue full training

Total disability period 5 days No training or games missed.

Case 50—Professional footballer received violent kick on anterior part of leg, over anterior tibial area immediately below right knee He collapsed in great pain and it appeared that a fractured limb was likely He was splinted and carried off the field on a stretcher but on examination in the dressing room it was decided that it was a bad contusion.

Cold compresses were applied, in the form of cotton wool soaked in ether meth. applied in a plastic bag This took place with no breaks for an hour a cold compress was bandaged to the leg whilst he took his bath, and a pressure bandage was applied before he was driven home.

He reported the next morning in a much improved condition with a slight swelling and pain on palpation there seemed to be no limit of movement and little pain on movement. He was given

short wave diathermy massage and exercises three times that day each session being followed by the application of a kaolin poultice and a pressure bandage.

He had two treatments on the following morning and with a pad of sponge rubber and an adhesive strapping over the area of the contusion, he was given a fitness test by the club trainer He passed successfully in all phases, finding no pain or limitation of movement in running kicking jumping or turning He played the next day and had no further trouble.

Total disability period 2 days Training missed 1 day No games missed.

Case 51 —Professional footballer received kick on dorsum of foot. Continued playing, but after the game was found to have discoloured and swollen area on the dorsum of the foot.

Liniment A.B C. was applied with a pressure bandage, and he was told to rest for 24 hours.

On further examination the swelling had subsided but there was discoloration and palpable tenderness. Histamine ionization was given twice daily with massage and exercises He was also given two sessions of short wave diathermy and three sessions (two at home) of exercises with the foot in hot water This continued for three days, during which time he carried out light training he commenced full training on the fourth day and played successfully on the sixth day

Total disability period 5 days Light training 3 days No games missed.

Case 52.—Professional footballer playing in a Wednesday evening mid week game, received an opponent's knee hard in the fascia lata region of the right thigh.

Cold compresses of cotton wool and ether meth. in plastic bag were applied for half-an hour and a pressure bandage with cold compress (lead and opium) applied during his bath. A well padded compression bandage with Liniment A.B C. was applied to enable him to go home. He was told to rest until the following morning and then report for treatment.

On examination the next morning the limb seemed slightly swollen, was very painful on palpation, and there was a considerable amount of limitation of movement. He was given half-an-hour's bathing in hot water then short wave diathermy massage, and exercises—this proced ure was carried out six times during that day After each session he was firmly bandaged with a kaolin poultice and an elastic bandage.

On the next day Friday there was some improvement, but still pain on movement and limitation. The treatment continued as for the previous day

The third day Saturday found the patient still limping at 9.30 a.m., when he reported in for treatment. He had two half hour

sessions of hot water bathing, two sessions of short wave diathermy and massage, with a considerable amount of active loosening exercise.

At 12 30 p.m. a firm adhesive-strapping support was applied to the thigh, which was first massaged with capsicum petroleum jelly and the player was given a test which involved sprinting turning, twisting kicking and jumping He passed successfully with little pain and no limitation of movement. He played in a 2nd Division match that afternoon and scored two goals!

Total disability period 2½ days No training 2½ days No games missed.

Case 53 —Racing-car driver overturned 500-c.c. formula car whilst racing at Goodwood, receiving injuries to the acromioclavicular region. Being rather a tough individual, he took little notice of this and had no form of treatment whatsoever for four days. At the end of that period he was brought along to the author's clinic with a very painful shoulder very little movement, and a bad temper!

There was some swelling over the acromioclavicular region, with a very painful area on palpation. He could only flex and extend the shoulder with difficulty and abduction and rotation were very limited. X ray showed no bony injury and treatment was given for contusions. Once daily he was given short wave diathermy massage and exercise, and the shoulder was supported with an adhesive plaster strapping over a pad of sponge rubber This individual was not the type of man who would carry out any form of home treatment or exercise. Subsequently all his treatment was compressed into one 50-minute daily treatment. Emphasis was placed on abduction and outward rotation during the exercise session, and movement became gradually easier

He was under treatment for ten days at the end of this period he was considerably better but still without full range of movement of the shoulder girdle, and he complained of pain on movement and during the night hours.

On the sixteenth day after the injury he announced *his intention* of again racing in two days time—he finished his treatment on the seventeenth day with some limitation of movement remaining and some pain He raced with varying success and did not return for further treatment.

Total disability period approximately 16 days.

(This case has been included to show that it is not always possible to treat patients under the pressure technique, nor is it possible to carry out treatment as one would wish on all occasions. There is a considerable amount of temperament in the sportsman, and the foreign athlete frequently has a marked *prima donna* attitude which does not make for easy treatment sessions!)

CHAPTER X

FRACTURES AND DISLOCATIONS

FRACTURES are possibly the most serious of sports injuries, happening more frequently than is generally supposed They usually occur as a result of violence, either external as when a heavy kick is received from the boot of an opponent, or internal through the powerful action of a muscle or muscle group Generally speaking, the fractures incurred in sport can be classified as being due to —

1 *Direct violence*—in which the bone breaks at the spot to which the violence is applied, occurring in conjunction with blows or falls This is a very common cause of fractures in athletics

2 *Indirect violence*—in which the bone is broken some distance from the area receiving the violence, in the manner of a fractured collar-bone being caused by a fall onto an outstretched hand.

3 *Muscular action*—the mere force of muscular contraction is sometimes sufficient to break a bone, as when a cricketer will fracture the humerus when throwing a ball into the wicket, sudden muscular contraction causing the damage. Ribs can be fractured by coughing and the patella is well known to fracture as a result of muscular contraction.

To the athlete the worst part of the treatment period following a fracture is that period when he is firmly incarcerated in a plaster-of Paris case. Unfortunately this measure is essential as continuous and complete immobilization must be maintained until sound union is achieved This, of course, means that the joints above and below the site of the fracture must be immobilized but every joint that is free must be actively exercised throughout the disability period. (*Fig* 32.)

The physiotherapist will not often be present when a fracture occurs, but should he be present it is an advantage to accompany

Fig 33 —Radiographs showing fracture of the carpal scaphoid.



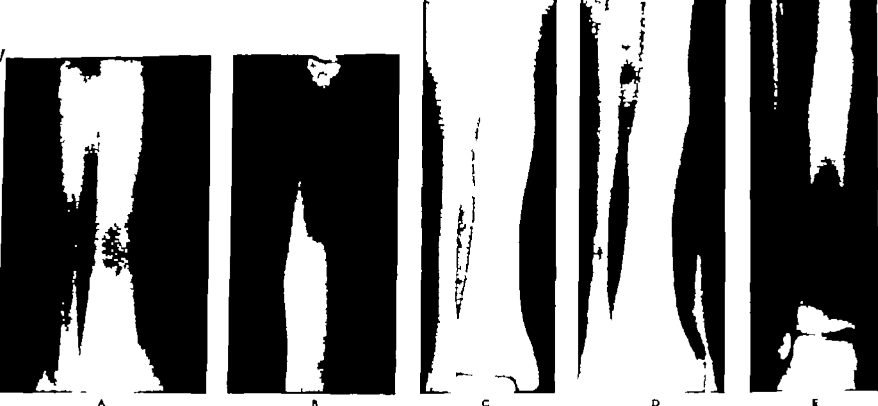


Fig 35 —A series of X-ray films of the twice-fractured tibia mentioned in *Case* 54. A, Taken on the day following the original fracture April 26, 1952, it shows quite plainly the fracture line running diagonally across the shaft of tibia at the junction of the lower and middle third. B, Taken on Nov 19 1953 after the man had been playing professional football for nearly two months. This film apparently ga e reason for assuming solid union. Note the callus formation. C, Taken on Feb. 11 1953 two days after the tibia had been fractured for the second time, the fracture line being clearly seen. D Taken on March 9, 1953 it shows that the fracture is still quite apparent. This film wa taken with the limb in plaster E One of a set of tomograms taken on May 8 1953 The tomographic cut shows the fracture line and the thickening of the cortex at the fracture site. There is no other abnormality



Fig 36 —A plaster-of Paris splint for fracture of the tibia and fibula with a pad fixed to the instep to allow the foot to rock during walking and to prevent a limping gait. (From Armstrong's *Aids to Surgical Nursing* published by Baillière Tindall & Cox Ltd)



Fig 37 —Bilateral fracture of the scaphoids showing the type of plaster cast used It extends to the metacarpal heads and includes the whole of the first metacarpal. The hand is tightly gripped so that there cannot be any trace of wrist movement, but the plaster in the palm does not extend beyond the transverse skin creases. (From Sir R Watson-Jones's *Fractures and Joint Injuries* published by E & S Livingstone Ltd)

When working under the routine of a pressure technique, the patient must be given a varied and interesting programme along the lines of those in use at residential rehabilitation centres He must never be allowed to seek pity to hang around listlessly watching his fit comrades carrying out their training He is given his training kit each morning and instructed to take part in the normal training programme with his team mates, doing every exercise and part of the programme of which he is physically capable. His exercises must be worked out in tables along progressive lines, and he must never be left alone to carry them out in his own time and under his own steam He should be encouraged, bullied, cajoled, and generally *jollied along with each specific group* his progress being marked on a chart and favourably commented upon

The player being treated under home techniques will be in rather a different position, because his rehabilitation will almost certainly be carried out under hospital auspices. Nevertheless, he must be encouraged and an interest taken in his progress, in just the same way as for the more fortunate athletes of the professional sports world. In both cases the injured athlete must have impressed upon him that success depends upon his own efforts, and that hard work will be required.

The principal aims of treatment in the rehabilitation of fractures are as follows —

1 To maintain muscular function during immobilization and to prevent muscular wasting

2. To conserve full function of the joints above and below the fracture.

3 To loosen stiff joints and to strengthen weak muscles.

4. To aid eventual movement of the affected part.

5 To keep the patient optimistic and cheerful.

The disability period will depend upon the gravity of the fracture, the speed of union, the length of time for which the patient is available during the later rehabilitation period, and the degree of knowledge and experience possessed by the physiotherapist. To go into further details of specific exercise tables and routines would be pointless as would the necessary detailed descriptions of the pathology and medical treatments,



Fig 36.—A plaster-of-Paris splint for fracture of the tibia and fibula with a pad fixed to the instep to allow the foot to rock during walking and to prevent a limping gait (From ARMSTRONG *Aids to Surgical Nursing* published by Baillière Tindall & Cox Ltd)



Fig 37 —Bilateral fracture of the scaphoids showing the type of plaster cast used. It extends to the metacarpal heads and includes the whole of the first metacarpal. The hand is tightly gripped so that there cannot be any trace of wrist movement but the plaster in the palm does not extend beyond the transverse skin creases. (From Sir R. WATSON JONES's *Fractures and Joint Injuries* published by E. & S. Livingstone Ltd)

that causes adhesions The correct treatment is to immobilize the torn tissues until they are healed, to continue exercises of the distal joints, and to begin movements of the injured parts after a specified period of a week or two Passive movements and stretching cause repeated tearing of freshly formed adhesions around a joint, leading to a reactionary exudation giving rise to the formation of fresh adhesions. Repeated daily, this greatly delays recovery and may permanently prevent full recovery Free, active exercise must be the treatment of choice.

There is considerable scope in the treatment of sports injuries for competent manipulative therapy although when carried out under anæsthetic it assumes the form of a two-edged sword Manipulation will undoubtedly break down adhesions, but the very process of so doing gives rise to fresh exudations and subsequent adhesion formation. Manipulation to break down adhesions around a joint should not be advised until the limb is no longer subject to recurrent œdema, nor whilst the adhesions are recently formed. It must be delayed until movement is no longer obtained on a progressively increasing scale by the patient's own active efforts

Case 54.—Young and highly promising professional footballer playing in a friendly match against his old club fell very heavily with his right leg caught between two other players. He was in great pain and completely unable to continue. On examination at hospital he was X rayed and the injury diagnosed as a fractured tibia. This was immobilized and he was brought back to the town in which he lived.

Further X rays by the club orthopædic surgeon revealed that the fracture was a transverse fracture, with no displacement, of the junction of the lower and middle thirds of the tibia (*Fig* 35 A)

He was placed in a walking plaster on the fourteenth day and carried on with his normal life (it was then the off season between playing seasons) playing golf walking and carrying out a full exercise programme under home conditions.

On July 7 1952 (10 weeks and 3 days after injury) the plaster was removed and the surgeon reported that it was united but not fully consolidated therefore not yet ready for vigorous exercises. He carried out knee ankle and foot exercises his quadriceps on removal of the plaster were as follows :—

	At 3 in.	*At 5 in.*
Right leg	15¾ in.	16¼ in.
Left leg	16¼ in.	18¼ in.

when so many admirable books exist giving these aspects in complete detail

During the period when 'treating and training' is taking place, and the athlete has his fractured limb immobilized in plaster, the physiotherapist must be alert to the danger of pressure sores. These occur through localized pressure of the plaster over bony prominences If an athlete complains of persistent localized discomfort or pain a search should be made for other signs such as local heat of the plaster over the area of the discomfort, smell or discharge, or a recurrence of œdema of toes or fingers after the initial swelling has subsided Later signs include the staining of the overlying plaster, but the condition will rarely reach this stage with an observant physiotherapist and a reasonably intelligent patient. The patient must never be made to feel that he has complained unnecessarily should there be no plaster sore present, otherwise he or his companions will be loath to complain in future and a pressure sore will be neglected until it has done considerable damage.

A complication of great importance in the world of sport is that of adhesion formation and joint stiffness, mainly caused by immobility and functional disuse. The patient is usually frightened to move the injured part too much, his instinct is to carry the limb in a sling or similar support, and to guard against the slightest sudden movement. Unless instructed otherwise with assurance and a certain amount of personality, he will continue to exercise with doubt and caution, reading ill omens in every initial discomfort. Every day of delay causes trouble, and an early start with regular, frequent sessions of adequate exercise must be ensured, even if it entails some degree of bullying!

Muscular inactivity causes venous and lymphatic stasis, the circulation is sluggish, and the tissues become waterlogged. Thus is formed a source of serofibrinous fluid which produces capsular and intramuscular adhesions. A simple uncomplicated joint injury does not cause serious or lasting stiffness, but if the joint is treated by early movement and the torn tissues are not protected, there is repeated exudation. It is this soaking of the tissues with fibrinous serum day after day

the immobilization was resumed. On May 8 (12 weeks later) the plaster was removed and a tomograph taken (*Fig* 35 E) This showed union to be complete and the player was permitted to commence a home routine of active exercises—the off season having come around again so that club treatment was not fully available.

On July 28 the player reported to the club with the other players and commenced a full and normal training programme with no adverse effects. He played his first game on the opening day of the season (Aug 22) and carried on throughout the season with no apparent limitations, either physically or mentally He finished up the last two months of the season as the regular first team centre-half.

	1st Fracture	*2nd Fracture*
Total disability periods	5 months	6 months approximately
Training	No training, nil (Close season)	No training 60 days
	Light training 5 weeks	Light training close season
Games missed	9 (Injury mostly close season)	13 (Until season ended)

Case 55 —Speedway rider New Zealand origin and very tough sustained compound fracture left tibia and fibula when he crashed into the safety fence during a race. The fracture was reduced and immobilized, but after two weeks was again treated under open conditions and vitallium screws were inserted The rider was in plaster from early October until the following April, during which time he stumped around in a walking plaster (*Fig* 36) and was employed in a garage. He received some rehabilitation in the gymnasium of the local hospital but was not regular with his attendances

On removal of the plaster there was marked wasting of the entire leg with considerable oedema and swelling around the site of fracture and the ankle of the affected leg Permission was obtained to treat the rider at the local football club s treatment room this was carried out daily and consisted initially of active movements in hot water and massage, the lower limb being supported with a heavy elastic weave-type bandage between treatment sessions.

After ten days the leg was considerably improved and the oedema had gone. Heavier exercises were commenced, using weights and pulleys and by the end of a fortnight there was a marked increase in muscle tone and volume. On the twenty first day after plaster removal the rider began gently to jog trot around the cinder track, and to use weighted boots in his quadriceps exercises and a 50-lb bar-bell across his shoulders whilst he carried out deep knee bends

Until Aug 8 he carried out the following daily routine of rehabilitation —

10.00–10 30	Re-education in walking
10 30–11 00	Quadriceps exercises
11 00–11 30	Trunk exercises
11 30–12.00	Foot and ankle exercises
2.00– 2 30	Quadriceps exercises
2 30– 3 00	Foot and ankle exercises
3.00– 3 30	Re-education in walking
3 30– 4.00	Quadriceps exercises

On Aug 11 the surgeon reported that the fracture seemed firmly united, and that the player could go ahead with training and, later playing "His leg may not be 100 per cent efficient as he still has some muscle wasting and I have told him that full consolidation of the fracture takes some time. He may therefore, get some aching after a strenuous game, but he need not worry about this."

The player therefore worked under a treat-and train routine until Sept. 2, his training becoming progressively more severe, until on Sept. 3 he commenced doing normal daily training with the other players He played his first game on Sept. 20 without incident and played at least once a week for the next 4½ months, playing in the centre half position.

On Feb 9 1953 he was again playing in a friendly match, under floodlight, against a R.A.F team, when he was seen to limp for a few seconds after about 15 minutes of the second half of the game. He *had received no noticeable injury and could recall* nothing, but after a few minutes it became extremely painful to put the right foot to the ground. He was assisted from the field and the contusion (as it was surmised) was treated with cold compresses and a pressure bandage, after which he was taken home in a taxi.

There did not appear to be any improvement in the leg on the following day but it was again conservatively treated and rested in a pressure bandage. On the third day the player felt convinced, from his past experience, that he had again fractured the leg. Radiography proved him right and the surgeon's report stated as follows

" Looking at his X rays carefully it is quite possible this tibia never united soundly because the fibula was not fractured and therefore the ends of the fracture were held slightly distracted. A refracture has now occurred through an insecure union. I am sure that this fracture will have to be held for a long time now and, finally grafting may have to be considered " The fracture was a transverse fracture of the junction of the lower and middle third, with no displacement. (*Fig* 35 C.)

At the end of six weeks, during which time all possible exercises were carried out by the player the plaster was removed and further X rays were taken. As there appeared to be good evidence of union,

subject of this case history was still a little dazed and was walked to the touchline, where the trainer led him slowly up and down to enable him to orientate himself After a few minutes he returned to the field and although obviously still a little dazed, played at the ball once or twice. Suddenly he fell to the ground with no other player near him, and was unable to get to his feet as he did not seem to be able to bear weight on his left foot.

He was carried into the dressing room, where the club doctor immediately diagnosed a fractured fibula. He was sent by car to hospital and the diagnosis was confirmed by radiography The leg was shaved, painted with Tinc. Benzoin. Co. and an elastic adhesive plaster applied from toes to tibial tuberosity with a sponge-rubber heel incorporated into the strapping

The player was given exercise routines twice daily for a week, and four times daily for a fortnight. The strapping was removed at the end of three weeks and the player commenced light training, but was unable to play again that season (a further two weeks) owing to a carbuncle forming on the calf of the formerly injured leg (*Fig* 40)

During his rehabilitation period from the fracture, he was given exercises for the foot, ankle, and quadriceps, using heavy weight resistance exercises in the later stages

Total disability period 2 months (including period of carbuncle) No training 15 days Light training 25 days Games missed 9.

Case 60.—Professional footballer an outside left, received a very heavy kick on the outside of the right leg He was treated on the pitch and was able to resume, although limping in a few minutes At the conclusion of the match the man was immediately laid on the massage plinth and cold compresses, in the form of cotton wool soaked in ether meth. in a plastic bag applied to the site of injury This was continued for forty minutes and a pressure bandage then applied.

On the following Monday after 36 hours rest, the leg was slightly swollen and bruising was visible around the site of injury and down to the dorsum of the foot. Short wave diathermy and light massage were given, followed by exercises in hot water The player was unable to bear massage other than of the lightest nature. This routine was carried out thrice daily for two days and on the Wednesday the player felt fit enough to undertake light training, trotting easily around the track for a few laps. There was still one small local area of extreme tenderness at about the level of the junction of the lower and middle thirds of the fibula. In the intervals between treatment sessions the injury was supported by crêpe bandage.

After completing a day's light training and treatment, on the next day Thursday the player was walking down a slight slope outside the ground when he stepped on a small stone. He said he felt a

He very rapidly improved and began to lift increasing amounts both with his quadriceps (reaching 55 lb.) and with the bar bell (145 lb.).

Wearing supporting elastic adhesive strapping he began riding five weeks after removal of the plaster and has continued to do so with no adverse effects and a *considerable measure of success.*

Case 56 —Ice hockey player fell heavily on to ice during game apparently spraining his right wrist. At the first treatment it was evident that the condition was very painful and had worsened since its occurrence, although radiographical evidence had discounted a fractured scaphoid. On the second treatment it was thought that further X rays should be taken, and he was accordingly dispatched to the local hospital, where the wrist was again X rayed, and again it was said that it was a severe sprain. Further treatment did no good whatsoever and once again the patient was sent along to the hospital for X ray—on this occasion a fracture was detected and he was put up in plaster (*Fig* 37)

The plaster was worn for five and a half months, during which time the patient worked hard at his exercises and did heavy manual work in a factory On removal of the plaster the arm was in such good condition that he played active hockey within ten days. (*Fig* 38)

Case 57 —Professional footballer fractured scaphoid when he slipped in his home At the request of his club his arm was put up in Glassons nylon-and-glass fibre fixation, and he continued playing professional football throughout the period of his injury (*Fig* 39) At the conclusion of the season he was able to swim and lead a normal life whilst still in fixation.

Total disability period 11 months Training none missed *Games missed none*

Case 58 —Professional footballer fell heavily on to outstretched hand during match. Continued playing and was treated with cold compresses and fixation for suspected strained wrist after game. On the following day X ray examination showed a chipped carpal bone (individual bone not known) and the lower arm and thumb were strapped in elastic adhesive plaster

In order that the man could play a glove was made of leather with a slab of Glassons affixed in a pocket along the palm, shaped in a cock-up position. The player played in this glove for three matches when the doctor declared that it was at that stage unnecessary The treatment during this period was exercises in hot water wax baths and support.

Total disability period 3 weeks Training normal, none missed Games missed none.

Case 59 —Professional footballer crashed into opposing player in extremely hard tackle both fell to the ground and had to be brought round with cold sponge, smelling salts, etc. The player who is the



Fig 38.—X ray of the wrist of the player in *Case* 56 which was taken seven months after the injury This film indicates that there has been an old fracture of the scaphoid which appears to have united well and to be in good position. There has also been a chip fracture of the dorsal portion of the rim of the articular surface of the radius, near the styloid process. This has not united and the condition now amounts to a mild traumatic arthritis the fragment can best be seen in the ulna deviated view



Fig 39.—Photograph of the Glassona fixation mentioned in *Case* 57

knife-sharp stab of pain in the region of the injury and he was completely unable to put his foot to the ground because of pain. He was assisted home and the club physiotherapist sent for who immediately saw that he was suffering from a fractured fibula—this was confirmed the next morning by X ray At the time of discovery the fracture was firmly immobilized by elastic plaster strapping, which was not removed at the hospital on the following morning.

The player was given thrice-daily exercise routines for the foot, ankle, and quadriceps using light weights. This was carried on until the end of the second week at that stage the limb seemed so good that much heavier type exercises were commenced including quadriceps exercises with up to 40 lb., and deep knee bends with 90 lb bar-bell, plus foot and ankle exercises standing on a brick, thus increasing dorsiflexion. From the end of the third week the player was able to undertake light training the plaster being removed in the middle of the fourth week. From the end of the fourth week onwards the player was in full training but continuing with the heavy weight exercises He played again at the end of the fifth week, and continued to do so for the remainder of the season with no adverse reactions

Total disability period 5 weeks No training 3 weeks Light training 1 week Games missed 6

Case 61 —A county cricketer received a hard blow whilst batting against a well known fast bowler He was unable to continue playing and found breathing difficult and painful. An X ray showed a fracture at the anterior end of the fourth rib on the left side near the costochrondral junction. There was no displacement, but a little callus formation could be seen in later X rays and the lung zones and bases were perfectly clear

Procaine injections were given every other day the area being strapped from midline to midline. Recovery was uneventful, except for a plaster dermatitis after three removals of the adhesive plaster for the injections Subsequently adhesive strapping was eliminated by using a heavyweight elastic weave bandage. The player resumed cricket after a week, wearing this bandage for a further ten days

Total disability period 1 week Games missed 1

Case 62 —Racing car driver injured when car overturned during race, sustained a fracture of the junction of the lower and middle third of the left ulna. There was no displacement and the limb was put up in plaster from the axilla to the knuckles with the forearm midway between pronation and supination, the limb being supported in a sling

The patient was given a routine of home exercises to be carried out whilst the limb was immobilized, including exercises designed

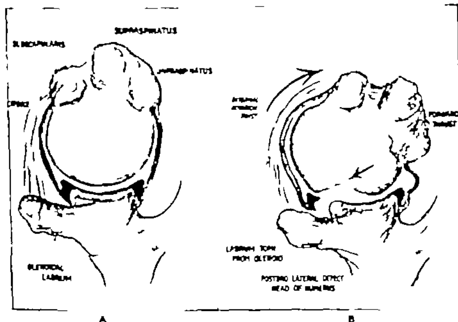


Fig 42 A.—Diagram showing the position of the glenoidal labrum in the normal shoulder (shaded in black) and the displaced portion in recurrent dislocation where as a rule there is also traumatic compression of a sector of bone in the posterolateral aspect of the humeral head (B) In these circumstances the head of the humerus slides forwards whenever the limb is externally rotated. (From Sir R. WATSON JONES's *Fractures and Joint Injuries* published by E. & S. Livingstone Ltd.)

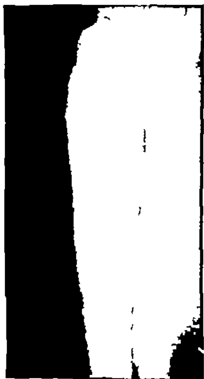


Fig 40.—Radiograph of *Case* 59, taken one month after the original injury and showing an old fracture at the junction of the middl and upper third of the left fibula. Good union is taking place without displacement.

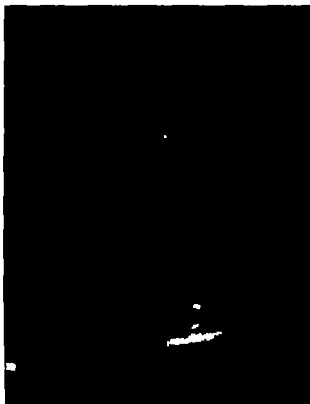


Fig 41.—*Case* 64. X ray film showing an undisplaced fracture of the neck of the radius, with small chip off the medial epicondyle

to mobilize all joints around the lesion and to maintain muscle tone and volume.

The plaster was removed at the end of the fourth week and active exercises were commenced to obtain movement at the elbow The rehabilitation was planned in two programmes as all exercises had to be carried out at home without supervision. The first scheme to be carried out for 14 days consisted of two daily sessions (15 minutes each) almost entirely confined to mobilizing exercises for all joints of the upper limb. After 14 days, a 10-day scheme of the same frequency included mobility type exercises and strengthening exercises for the muscles of the shoulder girdle arm, and forearm. The patient worked hard and was able to resume racing at Silverstone within eight weeks of receiving the fracture.

Case 63—Marathon runner, carrying out more than 100 miles each week as training, found gradually increasing difficulty in taking full weight on his right foot, pain being more noticeable on the dorsum of the foot. He assumed that it was due to a new pair of shoes that he was breaking in whilst training but on resuming his old, soft running shoes, he found the pain to be at least as great as before.

On investigation a march fracture of the third metacarpal bone was suspected, and the diagnosis was confirmed by X ray examination. The foot was strapped with elastic adhesive plaster and padded with sponge rubber and the athlete warned not to undertake any form of running for three weeks at least. As the man concerned was an Olympic Games possible this was serious and possibly meant the end of his chances, so a heavy non weight-bearing schedule was worked out for him. Working daily in a gymnasium for two hours, he carried out the heaviest work possible using weights and such exercises as lying bicycling whilst wearing 40-lb iron boots on each foot. All the exercises were non weight bearing and all were very strenuous! Specific remedial exercises were included.

At the end of the third week he was allowed gently to trot on grassland, and at the end of the fourth week was again able to resume long distances but not on the hard roads, all his work being confined to grassland. It was seven weeks before he was able to resume on the roads, but apart from resulting shin soreness, his training appeared to suffer very little from the enforced changes

Case 64.—Professional footballer fell on outstretched hand on hard pitch during an early-season game. Refused treatment at the time, but he was noticed to be moving about with the hand of the injured arm inside the front of his jersey On his return to the dressing room it appeared that he had some sort of fracture to the area around the elbow-joint. It was not possible to have X rays taken as it was by then late in the evening, so cold compresses were applied and the arm strapped firmly into position so that movement of the elbow was not possible

seventh week he was in full training with no restrictions and played eight weeks from the date of injury

Total disability period 8 weeks No training 28 days Light training 5 days Games missed 9.

Case 66 —The same player as in the previous case history playing in a friendly match, went up to head the ball and was headed in the face by an opponent. He was withdrawn from the game and cold compresses applied to the cheek and eye. After 36 hours rest the player's face was swollen and very bruised X rays revealed a fracture of the left inferior orbital process of the maxilla. There was no displacement and no need for fixation.

The player carried on his normal training routine, less heading the ball, for four weeks at the conclusion of this period he resumed his place in the first team.

Total disability period 1 month No training missed Games missed 4.

DISLOCATIONS

Of the three types of dislocations—congenital, pathological, and traumatic—the latter are the only type normally en countered in sport. Trauma is the most common cause of a dislocation the violence usually being indirect, and it may be associated with fractures of the bone which surround the joint.

The liability of any joint to dislocation depends upon its construction and the support given to it by surrounding ligaments and muscles plus the frequency of exposure to trauma as a result of its position Dislocation occurs most commonly in joints where stability has been sacrificed for mobility such as in the shoulder-joint. In this particular joint the articular surfaces do not fit well its surrounding ligaments and muscles are lax on account of its extreme mobility and it is frequently exposed to trauma (*Fig* 42)

Once reduced, the process of repair in the joint that has been dislocated consists of hæmatoma absorption, invasion of the clot by fibroblasts and capillaries and the formation of granu lation tissue which is converted into fibrous tissue. This process takes about three weeks, during which time the greatest single factor in aiding the reparative routine is rest of the injured part whilst carrying out mobilizing and strengthen ing movements of the surrounding structures

The aim of treatment is to limit adhesion formation, caused by the *formation* of excess scar tissue in the healing of capsular

Radiological evidence the following morning showed that the player had an undisplaced fracture of the neck of the right radius, with a small chip off the medial epicondyle (*Fig* 41). The arm was placed in a collar and-cuff sling A twice-daily exercise routine was instituted including finger and wrist movements and supported shoulder movements, and the man was instructed also to carry out these exercises at home.

The exercises progressively increased, with assisted active movements of the shoulder and elbow being included. After ten days the player began light training the arm still in the collar-and-cuff sling and at the end of the third week he was able to dispense with the sling and take his place with the other players carrying out full training He continued remedial exercises during this period. On the thirty-second day he again played football, being sufficiently fit to resume his place immediately in the first team.

Total disability period 31 days No training 10 days Light training 12 days Games missed 9 (early season period when two games per week were being played)

Case 65 —Professional footballer very vigorous and tough type, weighing 12 st. and being nearly 6 ft. in height, received very hard blow in the face from fist of goalkeeper early in match. Apart from cold sponge to bring him round, he did not receive or ask for any treatment either then or at half-time. In the second half he scored a goal with his head and was twice penalized for vigorous play On the conclusion of the game he mentioned to the trainer in a casual fashion, talking awkwardly that he thought he had broken his jaw at least something is wrong because I can t get my teeth together

At the local hospital the jaw was X rayed and a fracture of the horizontal ramus diagnosed. This was immobilized in the Dental Department by means of interdental wiring, a tooth being extracted in order that nourishment could be given. The player was retained in hospital for a week. On returning to his home he reported to the club and wished to keep in training in order that he might return to the team as soon as possible As there was no treatment possible in the club treatment room, he took his place with the other players and commenced training However after three or four days he had to admit that he could not carry out the training, as he appeared to lack energy and stamina this was considered to be due to the fact that he was unable to acquire sufficient nourishment of liquid form to enable him to maintain the high standards of bodily fitness for a full day's training Subsequently he was sent home and instructed to go for daily walks and to play golf frequently

The fixation was removed after five weeks, and the player began light training on the following day and full training six days later but he was not permitted to head the ball On the conclusion of the

and he continued playing On the conclusion of the game cold compresses were applied and the finger was strapped in elastic adhesive plaster

After 36 hours, treatment was commenced and consisted of anodal galvanism for 45 minutes followed by light massage and exercises Later on that day two further sessions were given consisting of immersion in a wax bath for half an hour and massage with exercises A light support was made that could be removed for treatment but at the same time gave adequate support The player was instructed to carry out hot water bathing at home exercises whilst in hot water with a rubber ball etc.

This routine was continued for five days and on the sixth day he played in a League match with his finger securely strapped A suggestion was made that the finger should be strapped to its fellow but this was rejected more for reasons of limitation of mobility than on physiological grounds.

Total disability period 7 days Full training maintained No games missed

Note—This player has a propensity for dislocating his little fingers, three further instances involving both hands having occurred subsequently in the following two years The treatment in each case was much as above, and strengthening exercises with a steel spring grip exerciser are constantly being carried out by the player at all times of the day

Case 68—This case was not treated by the author but is included because of its value in illustrating the dangers of recurrent dislocation of the shoulder joint. It is taken from an article in the *Practitioner* for April 1950.*

A recurrent subcoracoid dislocation of the right shoulder ended the career of an international goalkeeper at the age of 25 The shoulder dislocated several times when tipping the ball over the cross-bar He stopped playing football in March, 1935 In June, 1935 he dislocated the joint again while swimming in the sea and had to reach the shore by swimming on his back. It was our opinion that he would never play in goal again, and that operation would not alter this prognosis An orthopædic surgeon was consulted, who said there was a fifty fifty chance of making the shoulder fit by Clairmont's operation. The operation was done by another surgeon, who had even greater confidence in its success but the shoulder redislocated in the first half of a match in February 1936

Case 69—Australian speedway rider suffered from recurrent subcoracoid dislocation of the left shoulder He would frequently dislocate it, have it reduced at once by his team trainer (who was well drilled in this particular manipulation) and would continue racing

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* PEPPER, W G S., FRIPP A. T and TANNER, W E (1950) Injuries to the Professional Footballer" *Practitioner* 164, 298

and ligamentous tears which will limit movement. This aim can be achieved by maintaining the circulation of the limb as a whole, by moving the remaining parts of the limb whilst reducing activity in the injured parts to a minimum Adhesion formation is caused by effusion and movements of the injured joint during the repair stage break down delicate granulations, causing further bleeding and effusion

Immobilization is maintained by adhesive plaster strappings and bandaging or by means of bivalved plasters and plaster slabs.

During the rehabilitation period, when restoration of function is achieved all the psychological factors mentioned during the treatment of fractures equally apply The same stress must be placed by the physiotherapist upon maintaining cheerful and active interest in speedy recovery These same specific features apply whether the patient is being treated under pressure or home techniques and a maximum of supervised exercises are important

After the period of healing is complete, active movements should be instituted, avoiding massage and passive stretching, although massage to regions away from the joint will often aid in movement and prevent limitation. If after a reasonable period of time, active exercises fail to obtain any further improvement, a manipulation of the joint may have to be attempted. By this time the adhesions will have become avascular so that breaking them down will cause a minimum of hæmorrhage and effusion. Following upon the manipulation, early active exercises are essential.

In view of the prolific amount of excellent literature available dealing with the pathology and medical treatment of dislocations no attempt has been made to deal with those points in this chapter

Illustrative case histories of actual dislocations in the treatment of which the author has participated are included as being of instructional value.

Case 67—Irish international goalkeeper suffered dislocation of first interphalangeal joint of his left little finger when he received the ball following a hard shot by a close-in opponent. The finger was bent backwards. The dislocation was set on the field by his club trainer

CHAPTER XI

THE MISCELLANEOUS INJURIES OF SPORT

CERTAIN conditions will undoubtedly be encountered by the physiotherapist working in the world of sport that have not so far been considered in this volume, or which do not come under any of the headings hitherto mentioned Nevertheless, they are possibly as common as the sprain or strain and certainly equally capable of keeping a player from a vital game They are not necessarily difficult or particularly puzzling conditions, as will be seen.

Osgood-Schlatter Disease—The first condition considered lacks a title but owing to its similarity to Osgood's or Schlatter's disease, that title has been given to it. It is recalled however, that no acceptable evidence has ever been put forward that the condition is a disease, it is the result of a single injury or repeated minor traumata. The initial strain of extension movement of the knee, produced by contraction of the most powerful muscle group in the body is taken by the epiphysis of the tibial tubercle, which is supported laterally by the insertion of the tendon into the tuberosity of the tibia. The tubercle is developed as an epiphysis and it is not firmly fused to the tibia until the age of 18 years before that age the epiphyseal line is a weak point in the extensor mechanism of the knee A sudden flexion movement of the joint against the resistance of the quadriceps muscles tends to avulse the epiphysis from the tibia, but actual avulsion is uncommon because of the broad insertions of the medial and lateral expansions into the tibial tuberosity Minor strains are common as a result of the wear and tear of everyday adolescent life, although the condition may be perpetuated into adult life. Oddly enough, the author has not encountered an adolescent suffering from this condition, but three cases have been known in professional footballers whose ages ranged from 26 to 31

He would have a very painful night, with aching and pain, and the next morning there would be swelling and bruising would appear during the course of the next few days. He apparently had little, if any treatment on these occasions. He states that he can trace the joint redislocating ten times in three years, each time but one as a result of speedway racing the other occasion being when swimming

When seen by the author he said that the stage had been reached when the shoulder redislocated (or gave signs of being about to do so) almost every time he rode. Over a three-week period he was given extensive strengthening exercises for the muscles of the shoulder girdle, and the biceps femoris was built up by a pressure-technique system of weight-lifting along the lines prescribed by Delorme. A canvas half-jacket was made by a firm of surgical appliance manufacturers which had a short half-sleeve for the upper arm on the injured side of the body and which passed across the body to be buckled in the right axilla. Since this jacket has been used and the exercises have been regularly carried out, he has not suffered redislocation of the shoulder

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It is generally accepted in such cases that the symptoms have been present prior to the age at which fusion of the epiphysis may be expected, radiography showing irregular enlargement of the region of the tibial tuberosity However in no case encountered by the author has this been the case the condition appearing to be of recent origin and caused by recognized trauma.

Signs and Symptoms —Pain and tenderness accurately localized to the tubercle Pain is increased by active extension against resistance The tibial tubercle usually appears to be slightly enlarged when compared with the normal sometimes a lump is initially present and extension seems to be diminished in strength.

Cause —In each case there was a well remembered instance in which the player has been forced suddenly to flex his knee when the quadriceps muscles were in a state of contraction This incident usually seems to occur when a bunch of players attempt to reach a high ball and in coming down land on the shoulders of the player who has not left the ground, thus forcing his knees suddenly to flex.

Treatment —Working on the principle that further strain will possibly cause increased separation of the epiphysis and bony thickening will develop a small degree of immobilization is attempted. By means of a padded back-splint the knee is prevented from movement for a period of three days to a week, during which period four daily sessions of short wave diathermy are given followed by gentle active contractions of the quadriceps. When the player resumes active training and playing the area is supported by means of three layers of elastic adhesive plaster very firmly bound around the tibial tuberosities, immediately below the bend of the knee. In no case has the condition recurred after the original condition was treated in this fashion. Obviously it is essential that the athlete is instructed to carry out progressively increased quadriceps exercises on removal of the immobilization otherwise quadriceps insufficiency will cause one condition to be replaced by another

Shin Splints (Shin Soreness) —*This is a tearing or strain* of the origin of the tibialis posticus from the tibia in its lower third. The usual sufferers are athletes who have been training

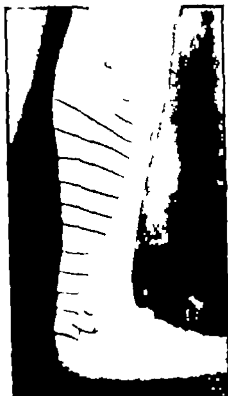


Fig 43.—Strapping of elastic adhesive plaster used to support the posterior tibial muscles in cases of "shin splints."



Fig 44.—Photograph of simply-made appliance for removing foreign bodies from the eyes.



Fig 45.—Photograph showing collodion and gauze dressing for sutured facial laceration.

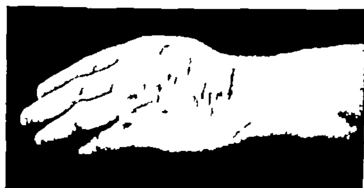


Fig 46.—A dressing formed by laminating layers of gauze with collodion, the whole covering superficial skin brasion.

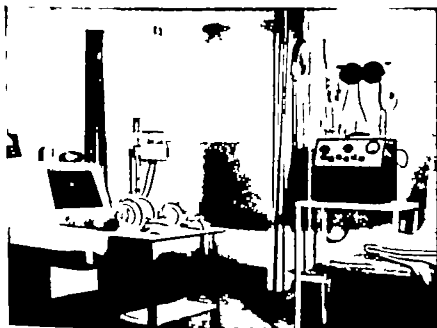


Fig 47 —The Treatment Room at Southampton Association Football Club

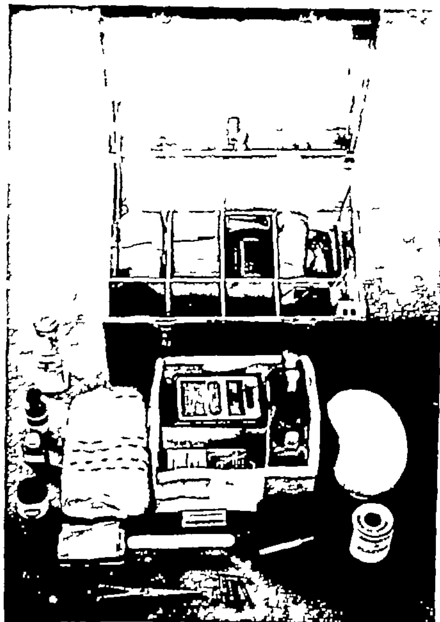


Fig 48 —A simply made first-aid box, to contain the necessary articles required by trainer or physiotherapist working with sports team during an actual game

or racing on hard tracks or on the road—the condition being caused by running on a hard surface early in the season before the muscles have acquired sufficient tone to fight off injury The continual, constant jarring causes pain, particularly on movement, in the region of the lower and outer third of the leg

This condition is most obstinate and slow to clear up heat and massage frequently appear to irritate the injured area, in which case rest, with non weight bearing exercises has been the treatment of choice No two cases appear to respond to the same treatment and methods of treatment carried out by the author include the following —

1 Short wave diathermy, with rest and non weight bearing exercises

2. Hot towels followed by massage of a squeezing nature in which the bulk of the calf muscles are pressed around the tibia and moved around the bone Exercises and strapping

3 Rest, with non weight bearing exercises and strapping

4. Massage with hot olive-oil, followed by exercises and support with a heavy elastic weave bandage.

In each case the athlete is given a sponge rubber heel to wear inside the heel of every shoe worn during the period of the injury At the same time he is warned not to change into low heeled slippers thus causing more strain on the posterior tibial muscles and their tendon of insertion The strapping in question is composed of overlapping separate strips of elastic adhesive plaster, bound in a three-quarter circular strapping so that the gastrocnemius is squeezed around the posterior surface of the tibia (*Fig* 43) This strapping will give almost instantaneous relief and materially aids in dispersing the condition although its effects only last for as long as it is maintained. However, if one is to follow the policy of supporting injured tissue the strapping, or some form of support, should be given whenever the patient is weight bearing

It is remotely possible to confuse this condition with a crack fracture of the fibula, and if doubt exists radiography should be used to establish the diagnosis

Injury to the Eyes.—Eye injury frequently occurs in sport but is outside the scope of the volume Minor injuries such as *foreign bodies in the eye* are easily treated, however The

foreign body may be particles of dust, metal, coal, insects, or eyelashes which may be under the upper or lower lid, on the cornea, or imbedded in the eye

Treatment.—The patient may be able to rid himself of the offending object by dipping his face under water and blinking his eye. Failing this, the patient should be seated in a good light and the offending object located by pulling down the lower lid, or turning the upper lid upwards over a probe or a matchstick. The object is then removed with the corner of a handkerchief, a camel hair brush, or one of the specially made instruments used by speedway riders for this purpose. It consists of a cocktail stick, at the end of which a very small loop of catgut is bound, the foreign body being gently removed by this loop (*Fig* 44)

Blows caused by tennis balls, boxing gloves, etc., are liable to cause damage to the delicate structures of the eye or to the back of the eye. The usual reaction is the black eye caused by bruising of the lids, which rapidly become swollen after the original trauma, a hæmatoma developing Cold compresses secured tightly by a pad and bandage may prevent a black eye from appearing, but to be successful this measure must be carried out very rapidly after the original trauma.

Lacerations and Abrasions.—These occur almost twice as frequently as any other sports injury but fortunately they rarely cause an athlete to miss a single game or event, possessing primarily a nuisance value. Few of these injuries are cleanly cut, but are irregularly torn and bruised, and may if neglected or incorrectly treated, become infected and serious. A laceration may vary enormously in extent and depth, depending upon the nature of the violence that caused the injury It may be defined as any injury in which the skin or mucous membrane is broken.

Generally speaking, wounds of this nature likely to occur in sport may be classified as follows (*a*) Incised wounds (*b*) Lacerated wounds (*c*) Punctured wounds (*d*) Contused wounds.

a Incised wounds Wounds in which the edges are sharp and well defined, having been generally caused by a knife or sharp instrument. However knives are not used in the best

conducted athletics and the incised wound of sport is usually caused by a blow from a blunt surface such as the toe of a football boot on tightly stretched skin The edges of the wound may remain closed, but more often they tend to gape particularly when the injured part is moved This type of injury may in some cases bleed profusely because blood vessels have been cut. Nevertheless, incised wounds can usually be quite satisfactorily cleaned and should heal in five to seven days, leaving little superficial scarring

b Lacerated wounds Those in which the edges are jagged, irregular and often bruised, and are usually caused by a blow from a blunt surface such as a cricket ball or a hockey stick This type of wound varies considerably in severity, the mildest being the abrasion or graze that most common of sports injuries. A lacerated wound rarely bleeds very much but heals up slowly, frequently leaving unpleasant scarring There is also considerable risk of sepsis

c. Punctured wounds A common injury of track athletics, when a spike of a running shoe pierces the skin. This often causes a small wound, but with a much deeper track hidden below the surface, in which severe complications can be caused by reason of germ proliferation. As this type of wound often has to be surgically enlarged (débridement) it is necessary for it to be seen by a doctor at an early stage.

The treatment of injuries of this type is amply covered by the following case histories (*Figs* 45 46)

Case 70.—Professional footballer received lacerated eyebrow when hit accidentally by opponent's fist during tackle. Player withdrawn from game and made comfortable on plinth blankets being used to avoid loss of body heat. The wound was cleaned with a solution of cetavlon and then packed with a quantity of penicillin styptic powder Four stitches were inserted by the club doctor after which the physiotherapist sealed off the wound with a laminated collodion and gauze dressing. The player was given two codeine tablets and a small drink of whisky and then returned to the field, 12 minutes from the time of receiving the injury

At the conclusion of the match the dressing was firmly adherent, although rather matted by subsequent bleeding It was tidied up and a further layer of gauze laminated onto the dressing

The following day the dressing was soaked off in warm water in which a few drops of Dettol were placed. The wound was cleaned

up and dressed with strip dressing The lesion healed without complication and the stitches were removed five days later the man playing on the following day

Disability period nil No training missed Games missed nil.

Case 71 —The same player as mentioned in the previous case history ten days after the above injury received another laceration of the opposite eyebrow when he was hit by a player's head. This was considerably more severe than the first injury and the player appeared to be suffering from a considerable amount of shock.

The injured man was made comfortable, and wrapped in two blankets as he was shivering and extremely shaken. The wound was cleaned with cetavlon and warm water five stitches were inserted, and the player given two codeine tablets and a cup of sweet, warm tea. A pressure-bandage type of dressing was applied. He rested, and eventually slept, for nearly an hour He was then assisted in bathing and taken home in a car Orders were given to him to remain in bed for 48 hours, during which period he was visited by the club doctor

On the third day the dressing was removed and the wound cleaned up the edges were in apposition and the lesion seemed in good condition. He was given a dressing of a less conspicuous nature, in the form of strip dressing with a dressing of sulphonated tulle gras. The player had been very shaken by this second injury following so closely on the original injury and showed no enthusiasm for training, playing or indeed anything connected with football. He was therefore sent home for 7 days, after which the stitches were removed and he commenced training, playing 19 days after receiving the injury

Total disability 18 days No training 9 days Light training 3 days Games missed 3

Case 72.—A professional footballer a centre-half, was knocked in the mouth by an opponent's head, causing his lower lip to be forcibly jammed against his bottom teeth. He was taken off the field and the wound examined. The teeth had penetrated the lower lip in two places, the interior of the lip being badly lacerated.

The wound was cleaned with warm water and Dettol (1–20) and one stitch applied, then the player returned to the game.

At the conclusion of the game, after he had bathed and dressed, the laceration was given a coating of Tinc. Benzoin Co applied with a brush.

The lesion healed up uneventfully in three to four days but left a loose flap of the lining of the lower lip this was not painful but had a nuisance value to the player which he considered interfered with his play Consequently the neck of the flap was tightly tied with a piece of catgut, and in a few days it dropped off.

Total disability period 10 minutes Training missed nil Games missed none.

Case 73.—Six-days bicycle rider received large skin burn on the right thigh when falling from his machine and sliding along the boards of the track. The wound was cleaned with soap and warm water and dressed with a protective coat formed of collodion mixed with a small amount of acriflavine in spirit. The lesion was kept covered by these means for three days, and at the conclusion of this period the wound was found to be dry and almost healed

Case 74.—Track runner fell whilst hurdling and sustained a large and dirty abrasion on the left knee There was a considerable amount of grit in the wound, which was not entirely removed by the normal routine of cleaning with mild Dettol and cotton wool swabs Subsequently the wound was scrubbed with a sterile nail brush and then dressed with acriflavine emulsion on a gauze pad, the whole being covered by a layer of cotton-wool and a crêpe bandage.

The wound was examined the next day and found to be slightly infected. A hot fomentation was applied using an antiseptic solution. The lesion was clean on examination the next day and an acriflavine emulsion dressing was again applied for three days after which the healing wound was painted with acriflavine in saline and a dry dressing applied. The lesion had almost cleared up completely eight days later when the man again competed.

Case 75.—Rugger player received a kick on the lower leg immediately below the knee. On examination there was a deep angry looking L-shaped laceration, with the inner part of the L forming a loose flap—the whole was encrusted with mud which had also been forced under the loose flap of flesh.

The player was given penicillin and A.T.S injections and the wound cleaned with cetavlon six stitches were inserted and a pressure bandage was applied. Codeine was given and a drink of hot, sweet tea.

The wound healed cleanly and uneventfully being dressed daily with sulphonated tulle gras and a pressure bandage The man played again, wearing a sponge-rubber protective padding on the seventh day

Total disability period nil Training missed nil Games missed none.

Case 76.—Professional footballer sustained large circular skin burn on his right thigh, caused by sliding on hip across hard, dry coarse grass pitch. The wound was gently cleaned with cetavlon, and dressed with a double layer of paraffin wax tulle gras, the whole being covered by elastic adhesive plaster This dressing was left intact for four days, and on removal there was little remaining but a pink, healthy looking patch. This was protected by a pad of sponge rubber held in place by zinc oxide plaster when the player again played on the fifth day

Total disability period nil Training missed nil Games missed none.

Case 77—Professional footballer sustained a long cut on the knee the edges remained in apposition but gaped on movement. The wound was cleaned with cetavlon, using cotton wool swabs with forceps in order to clean inside the laceration thoroughly

The wound was packed with penicillin styptic powder and then held together with two Herfe s clips, which were affixed through a pad of cotton wool laid along the wound. The clips were prevented from moving by a strip of ribbon gauze placed through their loops, and the ends fixed to the skin with plaster

On removal of the clips on the third day the edges of the wound were together and it appeared clean and healthy It was dressed for four days with acriflavine in saline and a dry dressing The player played again on the seventh day with a protective padding of petroleum jelly laminated collodion, and gauze.

Total disability period nil Light training 2 days Games missed nil.

CHAPTER XII

CONCLUSIONS

THIS volume is an attempt to formulate planned treatment routines for the more common injuries of sport which must inevitably mean the more common injuries of every walk of our daily lives. The injury sustained by the factory worker when hit on the thigh, for example, by a piece of metal is precisely the same injury that he would sustain if he were kicked on the football field. This means that the approach and technique used to return a professional footballer speedily to his team will, if adequately applied, return a worker to his bench, a pilot to his aircraft, or a housewife to her kitchen

The Chartered Physiotherapist is a suitably qualified person to treat the recent injuries of sport, industry and everyday life. His role will be to return the patient to his normal occupation in the shortest possible time. To do this there exists no miraculous method, no secret potion or revolutionary technique —it is merely a question of approach, coupled with a highly-developed sense of priorities. In the majority of cases the patient himself does the bulk of the remedial work, but his treatment routine must be planned, progressive, and systematic.

Various aspects of the treatments outlined herein ideally conform to the conditions applying within industry For example, few are of better value than the treat and train procedure in which the patient is kept at almost full activity by means of being made comfortably ambulant through treatment, strappings, and paddings. The industrial counterpart to this sports-injury system takes place at the works of Vauxhall Motors Ltd. of Luton, England. This organization has evolved a system whereby industrial physiotherapy and occupational therapy are provided for surgical medical, and functional cases whilst they perform useful work in a retraining

shop This shop operates on a production basis, the work for the purpose being diverted from the factory proper, and all personnel receive full pay during their rehabilitation.

The scheme works through the medium of a rehabilitation team consisting of a consulting orthopædic surgeon, a plastic surgeon, an industrial medical officer a rehabilitation superintendent, and industrial physiotherapists working from their own treatment room within the factory confines. The activities of this team are centred around a rehabilitation workshop built and equipped with a range of standard machines modified to provide remedial exercises. Continuity of treat ment from the moment of injury to the return to full work is the aim in every case, the team acting in group consultation at a weekly follow-up clinic held in the factory During this conference the patient s response to treatment is assessed and treatment modified where necessary so as to fit in with a planned programme of recovery

All the work done is of a production nature and the output of the shop contributes a useful quota to the production demands of the factory the shop operating at about 65 per cent efficiency as compared with the rest of the factory This in itself is a powerful incentive towards recovery, for not only does it provide a more realistic approach to treatment than the orthodox handicraft methods of the occupational therapist, but it also avoids the monotony of stereotyped routines per formed in a physiotherapy department. Moreover it creates a sense of responsibility in the patient as a working member of a team and gives him some tangible evidence of his usefulness to society Statistically during 1947 only 5 4 per cent of cases lost no working time, but during 1948 this figure rose to 68 per cent! Keeping both the athlete and the worker at their jobs is probably as significant psychologically as it is from the point of view of personal economics.

In all walks of life the average man will possibly recover in a reasonably satisfactory manner from an injury without these methods of rehabilitation. It is the role of physiotherapy to accelerate the patient s return to his normal occupation and, at the same time, eliminate as many as possible of the days of disability

No scheme of rehabilitation will be effective without a close working liaison with enlightened hospital and general practitioner services. These services must be prepared to accept new standards as to fitness for modified work or play of a selective nature, based on a first hand knowledge of what actually goes on within the worlds of sport and industry. No scheme can work without the willing co-operation of the patient plus good relationships between worker, whether he be a fitter or a footballer and the management side.

The more orthodox amongst us may inquire "Where does first aid end and physiotherapy begin?" When working in sport, or any similar atmosphere involving the necessity for a rapid return to action, the dividing line is nebulous and should hardly be considered to exist. If dressing a laceration enables a player to score a goal or a worker to maintain his rate of production, then that is physiotherapy so far as the physiotherapist is concerned and is consequently justified. The luxury of soft pedal diplomacy and ethical self-effacement by chartered physiotherapists is outmoded in every field particularly that of sport, where only results count.

This book is not claimed to be a complete text book on the subject of recent injuries, it is the record of a single physiotherapist's work and researches over a seven years period. If any specific condition or method of treatment is omitted it is because it is considered that adequate knowledge is lacking or that the author's experience therein is insufficient to make its publication worth while.

In this country where only half a-dozen competent and adequately trained chartered physiotherapists are able to earn their living treating athletes on a full time basis there is indeed scope and need for the enthusiastic physiotherapist and the equally convinced sports or industrial management who know that an hour spent in competent treatment will save an entire day's inaction

APPENDIX

THE FORMATION OF A TREATMENT ROOM

THERE is little attempt made in the world of sport to provide adequate premises to house the medical equipment and to give the physiotherapist facilities commensurable with his ability. Further an injured athlete will react far more favourably if he is treated in an atmosphere conducive to healing rather than in the centre of a crowded dressing room, surrounded by chattering and inquisitive team-mates.

The physiotherapist must have suitable premises in which to carry on his priority task, even if initially they consist of a screened-off corner of the dressing room. Ideally the treatment room should be situated so that it is easily accessible from the actual dressing room and bathroom. This enables the athlete to come straight into the treatment room without having to dress or traverse draughty corridors, etc. But the principal reason for its close proximity to the dressing room lies in the need for speed—the saving of those few minutes that it will take an injured player to come from the dressing room when the sole time at the physiotherapist's disposal for treatment lies in the five minutes of half time periods. (*Fig.* 47.)

Whilst the room should be clean and surgical in its appearance, it should also be bright and cheerful with an attractive colour scheme. It must be kept scrupulously clean and free from dust and dirt, with the floor covered in a material that is not cold or damp to the feet. Cork or rubber is possibly the ideal covering, but a good inlaid lino will also be quite suitable being easy to keep clean and pleasant in appearance.

There must be adequate sources of heat to keep the room comfortably warm, as it will often be the habitat of unclad injured athletes for considerable periods of the day. Muscle tissue does not relax well when in a half frozen condition. Lighting must be bright without being glaring and sited in

such a fashion as to prevent shadows being thrown onto the actual massage plinths These lights must be of sufficient height to preclude their being hit by waving arms during remedial exercises This applies also to the flex leading to electric fires and medical electrical apparatus ideally the fires should be suspended from the walls, and the leads of apparatus sited so that they do not cross the floor in a dangerous manner

All medical supplies should be kept in cupboards or cabinets preferably with glass fronts that slide back for access Some form of water-supply in the room is advantageous, whilst a water heater is invaluable An electric sterilizer is very useful and will pay for itself time and time again. The apparatus and medical supplies used in the treatment of open wounds should be kept in a surgical trolley drawer, strict aseptic precautions along theatre lines being carried out by means of a clean upper drawer and a dirty' lower shelf (*Fig* 48)

A high standard of behaviour must be asked of all who use the treatment room in this way and in this way only can the vital hospital atmosphere be encouraged which gives rise to the psychological uplift that plays such a big part in the treatment of an injured athlete, who is himself often something of a *prima donna*. The treatment room will often be the warmest room in the club for that reason the players will tend to congregate therein during their off-duty periods This must be speedily stamped out, access only being permitted to those men who actually require treatment, and not those who wish to arrange a golfing date with a patient. The treatment room must be out of bounds to all except the injured and notices to that effect prominently displayed. The same ruling must apply to smoking it is forbidden in the treatment room and that ruling must be shown in writing

Whilst it is important to make a man feel relaxed and comfortable in the treatment room, he must never be permitted to gain the impression that he has just become a member of a very comfortable and languorous club an impression which he rapidly assumes if he is permitted to lie reading books and papers during treatment. One hundred per cent concentration on his treatment and recovery by the man himself is essential, and for that reason reading during treatment is also forbidden.

Knowledge comes with experience and research the systematic keeping of records is a great factor to this end The competent physiotherapist will keep a daily log book or a card index system by means of which he is able to ascertain at a moment's notice the particular weakness of the player under treatment, any particular injury propensity, and the type of treatment to which he most quickly responds. It has been stressed throughout this volume that prevention is better than cure by means of records it is possible to forecast the likely onset of a specific injury to a player at any given time of the season.

If finance enters into the picture, economic measures can include the manufacture of remedial apparatus with clothes-line rope and pulleys weights formed by bags filled with sand or earth and clearly marked with their respective weights, etc. Massage plinths can be improvised from six foot trestle tables with mattresses, etc.

The importance of the work done by the physiotherapist has been sadly underestimated in the world of sport the task of establishing this badly needed facility is difficult enough without handicaps in the form of ill-organized premises and lack of system being permitted to encroach upon the priority work that is required.

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PRINTED IN GREAT BRITAIN BY JOHN WRIGHT AND SONS LTD., BRISTOL.